

1714

THE
PHYSICAL AND ECONOMIC DIMENSIONS
OF
MUNICIPAL SOLID WASTE MANAGEMENT
IN
ONTARIO

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**THE PHYSICAL AND ECONOMIC DIMENSIONS OF
MUNICIPAL SOLID WASTE MANAGEMENT IN ONTARIO**

Report prepared for:

**Fiscal Planning and Economic Analysis Branch
Ontario Ministry of the Environment**

NOVEMBER 1991



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ABSTRACT

The present study compiled information on the physical and economic dimensions of municipal solid waste management in Ontario. For the purposes of the study, the system was divided into three major components: waste generation, waste recycling, and waste disposal.

Waste generation was divided into two major generating sectors, namely: residential and industrial/commercial/institutional (ICI). Residential waste composition was estimated by combining information from a number of sources, including the recently completed study by Gore and Storrie. The study determined that the residential sector produced and estimated 3,901,900 tonnes of waste in 1987 and 4,053,200 tonnes in 1989. The major components of the residential waste stream are paper (36%) and organics (32%). The Blue Box program recycled approximately 97,000 tonnes (2% of the residential waste stream) in 1987 and 206,400 tonnes (5.1% of the residential waste stream) in 1989.

Industrial/Commercial/Institutional waste composition and generation rate information was obtained from a number of waste audits carried out in the Province. This information was divided into 25 ICI categories. Waste generation rates (kg/employee/day) and waste composition data (i.e. % wood, paper, etc.) were developed for each ICI category. This information was then combined with confidential county specific employment data to estimate the quantity and type of waste produced by each major ICI category in each county. The estimates were revised using actual county specific data, where available. Provincial totals calculated by this method were also revised using real data, where available.

The above method yielded an estimate of 5,189,000 and 5,361,000 tonnes of waste generated by the ICI sector in 1987 and 1989 respectively. Major waste categories included wood (1.3 million tonnes) paper products (1.221 million tonnes) and organics (0.6 million tonnes). The study identified 279,760 tonnes of ICI waste which was recycled in 1989. The actual figure is likely greater than this amount.

Waste generation rates in 1987 and 1989 are similar at approximately 420 kg/cap/year for residential waste, and 560 kg/cap/year for ICI waste.

Section 1

INTRODUCTION

1.1 BACKGROUND

In January 1990, the MOE Policy and Planning Branch awarded a contract to CH2M HILL ENGINEERING LTD. (with MacLaren Engineers as subcontractors) to develop a database on the Physical and Economic Dimensions of the Municipal Solid Waste Management System in Ontario. The study was carried out concurrently with three other studies to assess the socio-economic impacts of the waste diversion objectives announced on March 10, 1989. The objectives stated that 25% of the waste stream was to be diverted from landfill and incineration by 1992, and 50% was to be diverted by the year 2000. A base year of 1987 has been used for all of these objectives. The three other studies carried out concurrently, and the consultants awarded the contracts for these studies are as follows:

- Market Assessment of 3Rs Activities in Ontario (RIS & VHB)
- True Costs of Waste Management (VHB & MacLaren)
- Co-ordination and Synthesis (VHB & Econometric Research Ltd.)

1.2 STUDY OBJECTIVES

The objectives of this study were:

- i) To develop a complete picture of municipal solid waste management in Ontario in 1987 and 1989.
- ii) To use secondary data sources (i.e. published reports) to get information on sources and quantities of municipal solid waste; facilities for its handling and disposal; and, public, private and so-called third sector activities in solid waste management.
- iii) To summarize information on the physical and economic dimensions of municipal solid waste management in this report and also in a database format amenable to updating as more information becomes available.

1.3 REPORT STRUCTURE

This report has been structured to provide the reader with a readily accessible reference document.

Section 2 outlines data sources used in the study. These include secondary sources available at the time the study (1990) and primary research through telephone calling, surveys etc.

The first task of the study was to develop waste quantity estimates for both the residential and the industrial/commercial/institutional (ICI) sector for 1987 and 1989. The methods used and the results obtained are summarized in Section 3. The amounts of recycled and disposed waste are also presented.

Together, Sections 4 and 5 develop as complete a picture as possible on all facets of the municipal solid waste management system in Ontario. Section 4 addresses the traditional elements of solid waste management including landfills, incinerators, transfer stations, haulers, and the environmental protection industry (EPI).

Section 5 describes recycling, including the status of municipal recycling programs, material recovery facilities (MRF's) and private, public and so-called third sector recycling agents (recyclers). Each of these topics is covered in four subsections: general description; physical dimensions; economic dimensions; and future trends.

Section 6 summarizes study results.

Appendix A contains a list of references. Appendix B contains a copy of the Dun and Bradstreet Survey commissioned as part of this study. Appendix C contains descriptions of available funding for recycling programs. Appendix D contains a description of the database developed as part of this project.

Section 2

DATA SOURCES

To complete a comprehensive database including all aspects of solid waste management in Ontario, an extensive review of waste management activities at the county level, and where available, at the municipality level, was required.

To fulfil these requirements, the study has been divided into two stages of data collection: the waste generation stage and the waste management system stage. Various components of the waste management system are presented in Figure 2.1 for easy reference. Data generated during the two stages were entered into dBASE files for presentation and manipulation. As the waste diversion objectives are being measured with 1987 as the base year (adjusted for population growth), waste quantity data (generation, disposal and recycling) in the database are for 1987 as well as for 1989, where available.

2.1 MUNICIPAL SOLID WASTE QUANTITIES

Information was obtained on the waste quantities produced in Ontario in 1987, as well as 1989. It was desirable for the study to obtain waste quantity data on a sector-specific basis. Generators were segregated into two sectoral classifications: the residential/light commercial sector, and the industrial/commercial/institutional (ICI) sector.

Those municipalities and regions for which Waste Management Master Plans (WMMP) had been prepared at the time of this study constitute approximately two-thirds of Ontario's population. Information for the remaining geographical areas not covered by the WMMPs was provided using residential generation rates derived from the Gore and Storie Studies on residential waste in East York and Fergus.

Table 2.1 provides a list of the available WMMPs, all of which were reviewed and summarized as part of this study. WMMP documents do not contain all of the information necessary to adequately characterize the economic and physical dimensions of waste management. Extensive research identified a number of other sources which helped to fill the remaining information gaps following the review of the Waste Management Master Plans. A complete list of these secondary sources is summarized in matrix form in Table 2.2. The type of information obtained from each information source is noted in the table by a "X".

Residential and ICI waste generation information collected was disaggregated to the extent possible into fourteen specific waste types. To emphasize the potentially reclaimable materials, the complete list of waste types is derived from a prototype developed and used by Resource Integration Systems (RIS) in a related study. The RIS categories used throughout this study are presented in Table 2.3.

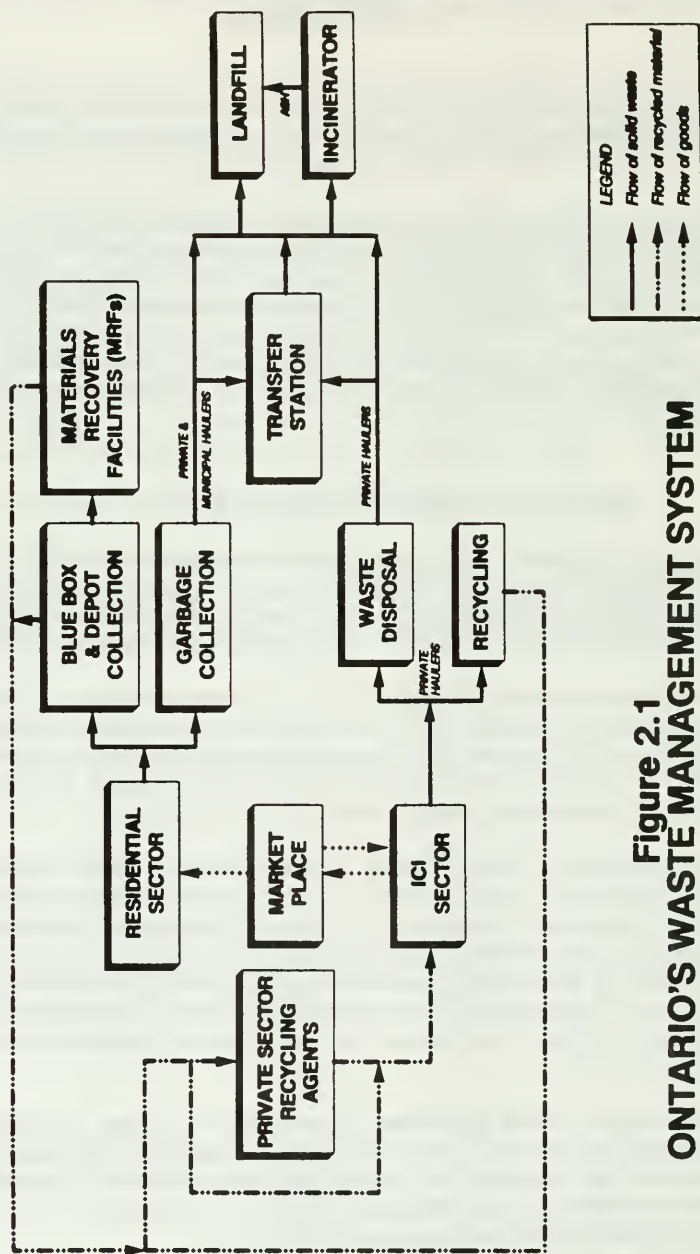


Figure 2.1
ONTARIO'S WASTE MANAGEMENT SYSTEM

Table 2.1
LIST OF WASTE MANAGEMENT MASTER PLANS (WMMP'S)
REVIEWED DURING MSW DIMENSIONS STUDY

County	Year Of Master Plan	Year of Data	County Served
Dufferin	1989	1988	Dufferin 100%
Easthope	1985	1984	Perth 12.95%
Essex	1986	1984	Essex 99.92%
Georgian Triangle	1989	1988	Simcoe 10.81% Grey 1.94%
Grenville-Dundas	1987	1986	Leeds & Grenville 45.37% Stormont-Glengarry 20.81%
Grimaby	1989	1988	Niagara 14.7%
Haldimand-Norfolk	1984	1983	Haldimand-Norfolk 100%
Centre & S. Hastings	1987	1986	Hastings 83.45%
Hawkesbury	1986	1984	Prescott-Russell 31.71%
Hearst	1986	n.d.	District of Cochrane 28.04%
Howland/Little Current	1987	1986?	Manitoulin 32.6%
Huron	1988	1987?	Huron 100%
Iroquois Falls	1989	1988	Cochrane 12.8 %
Kearney/Perry/ McMurrich	1989	1988?	Parry Sound 9%
Kenora/Keewatin/ Jaffray-Melick	1985	1985	Kenora 42.68 %
Kingston	1987	1985	Frontenac 45.68 % Lennox & Addington 33.66%
Niagara	1982	1981	Niagara Region 100 %
Northumberland	1985	1984?	Northumberland 100 %
Ottawa-Carleton	1985	1984	Ottawa Region 100 %
Parry Sound	1989	1988?	Parry Sound 46.06 % Manitoulin 2.91 %
Port Colborne/ Fort Erie	1990	1989	Niagara Region 11.33 %
South Simcoe	1987	1986?	Simcoe County 20.98 %
Pembroke	1988	1987	Renfrew 47.45 %
Peterborough	1988	1986	n.d.
Sarnia-Lambton	1986	1985	Lambton 79.55 %
Smith Falls	1987	1985	Lanark 98.53 %
Stormont-Glengarry	1988	1986	Stormont-Glengarry 36.28 %
Victoria	1989	1988	Victoria 100 %
Waterloo	1984 (revised)	1982	Waterloo Region 100 %
Wellington/Guelph	1989	1987	Wellington County 100 %
Sweep: Metro/ Durham/York	1988	1987	Metro/Durham/York

Table 2.2
SECONDARY DATA SOURCES USED IN MSW DIMENSIONS STUDY

Secondary Sources	Stage 1 - Waste Generation				Stage 2 - Waste Management System					
	Residential	Commercial	Industrial	Construction/ Demolition	Landfill	Transfer Station	Incineration	Haulers	Recyclers	Recycling Program
Waste Management Master Plans for 34 Municipalities and Regions in Ontario	X	X	X	X	X	X	X	X	X	X
Ministry of Municipal Affairs, 1989	X									
Municipal Directory, 1989										
Ministry of Treasury and Finance, Demographic Bulletin, 1989	X		X							
Scotts Directory, Ontario Manufacturers 1988 - 1989			X							
Standard Industrial Classification, Statistics Canada 1980			X							
Employment, Earnings and Hours Report, Statistics Canada, 1989		X	X							
Ministry of Industry and Trade, Made In Ontario, 1985			X							
Gore and Simcoe, Waste Composition Study, 1990	X									
Bird and Hale, 1978, Mun. Refuse Stats, For Canadian Communities over 100,000	X									
Franklin and Associates, Municipal Solid Waste 1960-2000, 1986 & 1988	X									
SWEAP, Discussion Paper 7.1: Towards A Solid Waste Master Plan, 1990	X	X	X							
TRAC, Composition Analysis of Refuse by Land Use in the City of Toronto, 1981	X	X								
SWISC, 3R Action Plan, 1990									X	X
Santa Cruz, Santa Cruz Waste Composition Study, 1985	X	X								
OMMRI, Blue Box Distribution Inventory, 1989										X

Table 2.2
SECONDARY DATA SOURCES USED IN MSW DIMENSIONS STUDY

Secondary Sources	Stage 1 - Waste Generation				Stage 2 - Waste Management System					
	Residential	Commercial	Industrial	Construction/ Demolition	Landfill	Transfer Station	Incineration	Haulers	Recyclers	Recycling Program
Toronto Home Builders Assoc., Making A Molehill Out of A Mountain, 1990				X						
EPA, Summary of Data on Industrial Non- Hazardous Waste Disposal Practices, 1985			X							
City of Seattle, Waste Stream Composition Study 1988-1989, Vol. I&II	X	X	X	X						
Windsor Regional Commission, Solid Waste Planning Project, Phase I&II,			X							
VIIIB, Generic Waste Management Alternatives Study, 1988			X							
MOE, Waste Disposal Site Inventory, 1988					X					
Woods Gorton Mgt. Consultants, Ontario Environmental Protection Industry, 1989										
RECOUNTS, Canadian Recyclers Directory 1987-1988									X	
OWMA, 1990 Annual Directory, 1990					X	X		X	X	
RIS, Report on Multi-Material Source Separation Pilot Project In ICI, 1989									X	
RCO, Markets Ltd., 1989									X	

Table 2.3
WASTE CATEGORIES TO BE USED THROUGHOUT MSW DIMENSIONS STUDY

Paper

- Newspaper
- Fine paper
- Boxboard
- Corrugated cardboard (OCC)
- Magazines
- Mixed paper (waxed/plastic/mixed)
- Telephone books
- Composite packaging
- Other (kraft, wallpaper, tissue)

Glass

- Food and beverage containers
- Other

Tinplate Steel

- Food and beverage containers
- White goods
- Other

Aluminum

- Food and beverage containers
- Foil (rigid and flexible)
- Other

Plastic

- PET
- HDPE
- Other Rigid
- Film

Organics

- Food wastes
- Yard waste (leaves, grass, weeds)
- Yard waste (other)

Wood Waste

Construction/Demolition Waste

Drywall

Other

Disposable Diapers

Used Tires

Household Hazardous Waste

Other

Waste Management Master Plans were used as the primary source for compiling waste generation figures for the residential/light commercial sector. Waste quantity data for Metropolitan Toronto, York and Durham were obtained from a 1987 Solid Waste Environmental Assessment Plan (SWEAP) Metro document prepared by Metro Toronto.

For the industrial/commercial/institutional (ICI) sector, it was determined that a breakdown of waste sources into a 25 category system designed by Econometrics Research Ltd. was the most useful for the study. The industrial/commercial/institutional categories, referred to as Input Matrix Categories (IMC), used throughout the study are presented in Table 2.4.

Research activity revealed a number of industrial waste composition surveys and audits conducted internally by Ontario and U.S. municipalities. The data in these surveys was used to develop a waste composition database for the 25 IMC categories. The studies used originated from Essex-Windsor, Cornwall, Seattle, Washington, and Brattleboro, Vermont.

2.2 LANDFILLS

A database describing 730 landfill sites was developed using information obtained from Waste Management Master Plans, MOE Site Summary Reports, the MOE Inventory of Open and Operating Landfills, and results of a mail survey conducted by VHB Research Ltd. in association with MacLaren Engineers. It is estimated that this database covers greater than 90% of landfill capacity in the province. Many of the remaining landfills (approximately 670) serve northern municipalities of less than 1,000 people.

The primary sources of information on landfilling used in the preparation of this document were MOE Site Summary Reports. Where available, the information obtained from the reports includes data on the following items, although in some cases data for all items were not available:

- Certificate of Approval holder and address
- Site operator and address
- County
- Location
- Concession and lot number
- Name of municipality served and population
- Estimated remaining life
- Total annual tonnage received

Table 2.4
AGGREGATION OF INDUSTRIAL/COMMERCIAL/INSTITUTIONAL
ESTABLISHMENTS INTO 25 INPUT MATRIX CATEGORIES FOR MSW
DIMENSIONS STUDY

Input Matrix Category (IMC) Number	Description	Canadian 2 Digit Major SIC Categories Included
1.	Agriculture: agriculture forestry fishing, hunting and trapping	01,02 04,05 03
2.	Mining: metal mines mineral fuels non-metal mines services incidental to mining	06 07 08 09
3.	Food and Beverage Industries	10, 11
4.	Rubber, Plastic and Leather Industries	15 - 17
5.	Textile, Knitting Mills and Clothing Industries	18, 19, 24
6.	Wood Industries	25
7.	Furniture and Fixtures Industries	26
8.	Paper and Allied Industries	27
9.	Printing and Publishing Industries	28
10.	Primary Metal Industries	29
11.	Metal Fabricating Industries	30
12.	Machinery Industries	31
13.	Transportation Industries	32
14.	Electrical Products Industries	33
15.	Non-metallic Mineral Products Industries	35
16.	Chemical and Chemical Products Industries	37
17.	Miscellaneous Manufacturing Industries	39
18.	Other Major Manufacturing Industries: tobacco products industries petroleum and coal products industries	12 36

Table 2.4
AGGREGATION OF INDUSTRIAL/COMMERCIAL/INSTITUTIONAL
ESTABLISHMENTS INTO 25 INPUT MATRIX CATEGORIES FOR MSW
DIMENSIONS STUDY

Input Matrix Category (IMC) Number	Description	Canadian 2 Digit Major SIC Categories Included
19.	Wholesale Trade Margins	50 - 59
20.	Construction	40 - 44
21.	Transportation Margins	45 - 47
22.	Communications and Services:	
	communications	48
	owner occupied dwellings	
	finance, ins., and real estate	70 - 76
	education and health services	85, 86
	services to business management	77
	personal and misc. services	97
	amusement and recreation services	96
	accommodation and food services	91, 92
23.	Electrical Power and Gas	49
24.	Retail Trade Margins	60 -65, 69
25.	*Other Sources:	
	operating office, lab, and food	81 - 84
	travel, promotion and advertising	98, 99

• IMC 25 contains SICs not accounted for in other IMCs, namely:

SIC	81 -	Federal Government Service Industries
SIC	82 -	Provincial and Territorial Government Industries
SIC	83 -	Local Government Service Industries
SIC	84 -	International and Other Extraterritorial Government Service Industries
SIC	98 -	Member Organization Industries
SIC	99 -	Other Service Industries

No Site Summary Reports were available for landfills located in the northeast and northwest regions of Ontario. It is estimated that there are greater than 700 small landfills in these areas serving small communities. The MOE Inventory of Open and Operating Landfills was consulted, however it did not provide additional information not found in the Site Summary Reports. Because there are such a large number of landfills in the northwestern and northeastern regions of the province, it was determined that only those serving a population of reasonable size would be placed in the database. A listing of landfills serving over 1,000 people was received from the MOE Northwestern Region office and the MOE Approvals Branch supplied a listing of landfills serving over 1,500 people for the Northeastern Region. Only location information was provided to the study team. This information was entered into the database. More information can be added as it becomes available.

Thirty-eight (38) Waste Management Master Plans were reviewed as part of this study. Some additional landfills not in the Site Summary Reports were identified and added to the database. The information on these landfills was also limited to location only.

Additional information for a number of the landfill sites was obtained from a survey carried out by VHB/MacLarens as part of a concurrent study and included:

- Remaining life
- Capital and operating costs
- Staff requirements
- Total annual tonnage received
- 1989 tipping fee

This information was added to landfill information provided by the Site Summary Reports, and supersedes all other data sources on landfills, since it is the most recently available information.

2.3 INCINERATORS

Only three incinerators in operation in Ontario receive MSW. The information on these incinerators was gained through direct telephone contact, since only one of the incinerators participated in the survey conducted by VHB/MacLarens in a concurrent study.

2.4 TRANSFER STATIONS

Information pertaining to location, capacity, source of wastes, final disposal location and pertinent economic data on transfer stations, where available, was compiled from Waste Management Master Plan data. A 1986 report to SWEAP by MacLarens provided additional information on Metro Toronto facilities. Employment data were

obtained directly through telephone contact with the Metro Public Works Department staff.

2.5 HAULERS

Waste haulers provide the necessary link that ties together the various components of the waste management system. Future decisions regarding waste management may have a significant impact on this industry. In order to understand the complexity and sensitivity of the industry to changes in waste management strategies, data identifying the key players were compiled, including:

- location
- regions served
- sectors served
- annual sales figures
- any other business activities
- employment
- amounts handled
- prices charged
- equipment used
- operating costs

These data were compiled from a combination of the results of a Dun and Bradstreet survey commissioned as part of this study and the OWMA (Ontario Waste Management Association) Members Directory.

2.6 RECYCLING PROGRAMS

Residential recycling has taken a prominent position among Ontario's traditional waste management strategies in recent years. Information pertaining to Ontario's municipal recycling programs (including curbside pick-up, depot collection, and fundraising events) was gathered from a number of sources in MOE, and also from an extensive survey carried out by RCO in 1987. Other useful information included the names of municipalities participating in the programs, the capital and operating costs for the programs, the types and quantities of materials collected through the programs and the revenue generated by the program.

Being a recent phenomenon, the level of data gathering and reporting has not kept pace with the level of recycling activity. Municipalities have concentrated on the start-up and maintenance activities associated with recycling and until recently, have had little time to develop data records. Consequently, documented records of recycled materials came from a variety of sources, some of which are more accessible than others.

A number of sources report on recycling activities in 1987 and/or 1989. Some are more limited in their usefulness than others. Each of these is described briefly below:

- Recycling Council of Ontario (1987) Municipal Source Separation Programs in Ontario.

Over a period of three years, from 1985 to 1987, the RCO was assigned by the Ministry of the Environment to document the amount of Blue Box materials accumulated through the municipal recycling programs. Information is provided in disaggregated form for each material type and municipality operating a recycling program and was obtained through personal telephone interviews conducted with each program's recycling coordinator.

- Resource Integration Systems (1990) Market Assessment of 3R's Activity

RIS, in conjunction with VHB, prepared a report on the recycling market's development in 1989 and the potential for future development. The report identified key materials targeted for diversion in municipal recycling programs. Markets were assessed by the quantity of materials recycled in 1989 and their ability to absorb more materials in the future.

- Ministry of the Environment (1989) Municipal Recycling Support Program

In order for municipalities to receive capital and operating grants for the Blue Box program, the Ministry requires program operators to submit annual reports on the costs incurred and the amount of materials recycled at the end of the fiscal year. This policy has been in effect since the mid 1980s; however, the practice of producing accurate and reliable records has not. In the early years of the Blue Box program, municipalities did not have the mechanisms in place to keep up-to-date records of the quantities of materials being recycled. Data prior to 1989 have a great deal of uncertainty associated with them. Provincial totals are reported for 1989.

- Ministry of the Environment (1990) Closing the Loop - The 3Rs of Waste Management

This publication lists a series of figures relating to the amount of material diverted by a single household Blue Box each year.

- **OMMRI (1990) Databank**

OMMRI has produced, for public viewing, a document summarizing Blue Box and related activities in Ontario. The document summarizes the quantity of material collected in a single Blue Box each year.

2.7 MATERIAL RECOVERY FACILITIES

The initiation of curbside recycling in Ontario has necessitated start-up of sorting and processing facilities to prepare recycled materials for the private sector recycling agents and/or end users.

Data on these facilities were obtained from a survey conducted by VHB/MacLarens in a concurrent study. Information obtained included:

- employment
- capital and operating costs
- business activity (eg. manual sorting, mechanized sorting, etc.)
- source of waste (i.e. residential or ICI)
- materials handled
- municipality served

2.8 RECYCLING AGENTS (RECYCLERS)

One of the important players in the area of waste management, particularly in the area of waste diversion, is the recycling industry. The arrival of the "Blue Box" at the curbside triggers a sequence of responses which enables the materials to be collected, sorted, processed, marketed and remanufactured. The coordination of these activities reflects an extensive market infrastructure. To foster a greater understanding of the recycler's role and responsibility, this study focused on the following information:

- company name (including private or third sector collectors, brokers, dealers processors, end users)
- location
- staff and equipment requirements
- materials handled
- value of business
- municipalities served

The information was gained through the Recycling Council of Ontario and a survey by Dun and Bradstreet which was commissioned as part of this study.

2.9 DATA LIMITATIONS

The task of generating a comprehensive databank of waste management activities for the designated base year of 1987 has, from the beginning, set a number of limitations on the amount and accuracy of data retrievable.

Since the early 1980's, the Ministry of the Environment has encouraged municipalities to implement long-term waste management strategies. Since then, most municipalities have engaged in the process of developing Waste Management Master Plans. As indicated previously, one of the focal points of the secondary research had been the Waste Management Master Plans. Unfortunately, while waste management has assumed a high priority among municipal government activities during the late 1980's, it did not command a great deal of attention prior to that. Consequently, local governments are scrambling to understand the intricacies of their waste collection and disposal system. As a result, many of the figures cited in available reports (including WMMP's) represent estimates only, the reliability of which remains uncertain. This condition pervades most of the secondary sources of information citing 1987 figures. In fact, when locating a relevant secondary source, it is not uncommon to find information for the years subsequent to 1987 but not including 1987.

For this reason, data for 1989 were included in the study. These are considered more reliable, as improved record keeping efforts had been initiated in many areas by that time.

A similar situation exists with industrial/commercial/institutional waste composition data. This was of little interest to municipalities until the last year or two, but as landfill bans on some materials came into effect, it is obvious that very little information has ever been collected on the composition of ICI (industrial/commercial/institutional) waste disposed at landfills. A number of municipalities are initiating studies on waste composition at this time. The results will be available within a year but generally not in time to be used in the present study.

Despite the data limitations, the available data provides a working snapshot of the physical and economic aspects of Ontario's waste management system. The database developed for the purpose of the study can be updated in future as more accurate data become available.

Section 3

WASTE GENERATION AND DISPOSAL PATHWAYS

3.1 GENERAL

This section presents information on quantities and composition of residential and ICI (industrial/commercial/institutional) solid waste generated in Ontario. A discussion and summary of recycling in Ontario follows, along with available data on the amount and types of materials involved. Wherever possible, data are compared to alternative sources of information to substantiate their accuracy.

3.2 RESIDENTIAL SOLID WASTE

3.2.1 Composition Data

Numerous studies have estimated and/or measured residential solid waste composition in the last twenty years. This section briefly reviews those studies of major importance to Ontario. Section 3.2.2 compares the various data sources and presents a composition which is representative of residential solid waste generation in Ontario in 1987 and 1989.

Gore and Storrie Ltd. in Association with Decima Research Ltd. 1990. Ontario Waste Composition Study. Reports to the Ontario Ministry of Environment,

Gore and Storrie carried out large waste composition study for the MOE Waste Management Branch. As part of this study, residential waste composition studies were carried out in Fergus (population 6,757), East York (population 101,085) and North Bay (population 51,313). The results of the Fergus and East York studies were available to the CH2M HILL study team on a confidential basis for use in the present study.

The methodology used in the Gore and Storrie studies is as follows. Fergus and East York were divided into Enumeration Areas (EAs) containing 600 people in each, deemed to represent a range in socioeconomic status. Residential waste was collected from each of the 14 EAs (6 in Fergus, 8 in East York), twice per week for a five week period. The waste collection for the study was carried out in July and August 1989 in Fergus and in November and December 1989 in East York. The collection produced 10 samples of at least 100 kg each, for each EA. The sampling included both single and multiple family dwellings. Yard wastes were collected and weighed, but were not included in composition or generation rate calculations since their amounts vary on a seasonal basis. Blue Box Recycling programs are in place in each municipality and items from the Blue Box were tallied separately.

The method for estimating waste generation rates in the Gore and Storrie study involved collections of garbage separate from those used to estimate waste composition. Rather than using data on total weight of garbage collected for a given transfer station or landfill and dividing by the population served, total weight of collections from a small number of residences was divided by the estimated number of residents (approximately 25 to 30). This provided an estimate of generation rates before Blue Box items were removed from the waste stream.

The Matrix Management Group 1989. Waste Stream Composition Study 1988-1989. Report to the City of Seattle, Department of Engineering, Solid Waste Utility.

A total of 212 random samples were collected over a period of one year in an area of Seattle, Washington, (population 490,000) served by two transfer stations. Samples were collected for a full year, so as to accurately capture the production of yard wastes and other seasonally variable components. Information about waste composition (after recycling), and generation rates were collected at the transfer stations, and socio-economic data about the sample areas were provided by the waste haulers. As with the Gore and Storrie study, waste was collected from both single and multiple family dwellings.

Franklin Associates Ltd., 1988. Characterization of Municipal Solid Waste in the United States 1960-2000, Report to the U.S. Environmental Protection Agency.

A literature search was conducted to determine historical rates of production and consumption of goods in the United States, beginning in 1960. A "waste fates" computer model was used to estimate the composition of residential and light commercial waste, based on consumption figures. No direct sampling of waste was carried out for this study.

Bird and Hale Limited, 1979. Municipal Refuse Statistics for Canadian Communities of over 100,000. Report to Environment Canada

Residential and light commercial waste from Canadian cities with a population exceeding 100,000 was collected and analyzed in 1978.

Evans, B and Paine, R.L., 1984. Composition Analysis of Refuse by Land Use in the Core of the City of Toronto. Report to the Toronto Recycling Action Committee (TRAC)

Garbage was collected from seven sample areas (3 residential, 4 commercial), which were deemed to represent "typical" urban areas and to contribute significantly to the Municipal waste stream. The samples, which were comprised of at least 100 bags of

garbage each, were collected prior to 9:00 a.m. in late August of 1984. The sorting took place at the City of Toronto Public Works Yard. No municipal Blue Box recycling program was in place at the time of the study (1984).

3.2.2 Comparison of Residential Waste Composition Data Sources

Data from the Gore and Storrie studies were analyzed by CH2M HILL, in order to obtain overall residential waste composition values for Fergus and East York, both before and after recycling. This allowed some general comparisons with data from the other sources described above.

One of the difficulties in comparing the data from various studies is that each study uses its own set of waste stream component descriptions depending on which are of interest to the particular study. In addition, some studies report composition before recycling activity removes certain components from the waste stream, others afterwards. In an effort to compare these data sources, waste stream components from each study were regrouped as shown in Table 3.1. The resulting calculated compositions are presented in Table 3.2 for comparison.

The Bird and Hale, Metro Toronto (1984) and Franklin data should be compared to Gore and Storrie before recycling results. Seattle data which were collected after recycling can be compared to the Gore and Storrie after recycling results. However, it should be noted that because reported waste generation rates vary between the various studies, comparing reported percentages may also be of limited value. In spite of the various limitations the following observations are noteworthy:

- Reported food waste composition is 19.69% for Seattle, 26-27% for Fergus and East York before recycling and 31% for Fergus and East York after recycling. These may appear to be significant differences, but if the generation rate for food is calculated using total per capita waste generation figures shown in Table 3.2, Seattle generates 0.29 kg/cap/day of food waste, compared to 0.26 kg/cap/day for Fergus and East York.
- Franklin reports food waste to be a relatively small percentage of the waste stream (10.64%) whereas all other studies reported food wastes to be 19.69-31.91% of the waste stream.
- All of the studies report three components as significant percentages of the waste stream, namely
 - newspaper
 - mixed paper/magazines
 - food wastes

The reported percentages vary significant between studies, as shown in Table 3.2.

Table 3.1
RE-GROUPING OF WASTE DESCRIPTIONS USED IN OTHER STUDIES
INTO GENERAL WASTE CATEGORIES

General Categories Used to Compare Study Results	Regrouping of Waste Descriptions Used in Other Studies				
	Gore & Storrer	Bird & Hale	Franklin	Seattle	T.R.A.C. (Toronto)
Newspaper	Newsprint	Newsprint	Newspaper	Newspaper	Newsprint
Fine Paper	Fine Paper CPO/Ledger	Fine	Office Paper	Office paper Computer Paper	Fine
Boxboard	Boxboard	Not Reported	Not Reported	Not Reported	Brown Paper
OCC	OCC	Kraft	Corrugated Boxes	Corrugated Paper	OCC
Mixed Paper/ Magazines	Magazines/Flyers Waxed/Plastic Kraft Wallpaper Tissues	Other	Books/Magazines Printed Tissue/Towels Other	Mixed Scrap Other	Other
Glass	Glass (total)	Glass (total)	Glass (total)	Glass (total)	Glass
Packaging	Not Reported	Not Reported	other paperboard Paper Pack. Misc. Pack.	Not Reported	Not Reported
Aluminum	Non-Ferrous Metals(total)	Non-Ferrous Metals(total)	Aluminum (total)	Aluminum Cans Containers Non-Ferrous Metals	Non-Ferrous Metals
Template Steel	Ferrous Metals(total)	Ferrous Metals(total)	Steel (total)	Tin Bi-Metal Cans Mixed/Ferrous	Ferrous Metals
White Goods	Not Reported	Not Reported	Appliances	White Goods	Not Reported
Rubber/Leather/ Textiles	Rubber/Leather/ Textiles	Rubber/Leather/ Textiles	Rubber Tires	Rubber Prods. Tires	Not Reported
Yard Wastes	Yard Waste	Brush Fines	Yard Wastes	Prunings Leaves and Grass	Vegetation
Food Wastes	Food Waste/ Rodent Bedding	Putrescible	Food	Food	Food wastes
Wood Wastes	Wood	Lumber	Not Reported	Wood	Wood
Construction/ Demolition	Ceramics/Rubble Fiberglass/ Gypsum Board/ Asbestos	Ceramics/ Rubble	Not Reported	Rocks/Concrete Soil/Dirt/Fines Gypsum/Drywall Fiberglass Debris	Not Reported
Diapers	Diapers	Not Reported	Not Reported	Diapers	Not reported
Household Hazardous Waste	Household Hazardous Waste	Petroleum Chemical Mix	Not Reported	Hazardous Waste	Not reported
Other	Dry Cell Batteries Kitty Litter Medical Waste	Not Reported	Clothing/footwear Misc. Undurables Misc. Inorganics Furniture Misc. Durables	Textiles Leather Ash Porcelain/China	Textiles Combust. Non- Combust.

Table 3.2
COMPARISON OF WASTE COMPOSITION PERCENT AND GENERATION RATES FOUND IN OTHER STUDIES TO GORE AND STORRIE (1990) RESULTS

Component	Bird & Hale 1979 (%)	Metro Toronto 1984 (%)	Franklin 1988 (%)	Seattle 1989 (%)	Gore & Storrie Before Recycling		Gore & Storrie After Recycling	
					Fergus (%)	East York (%)	Fergus (%)	East York (%)
Newspaper	9.76	16.70	6.23	7.10	14.95	23.11	6.44	11.06
Fine Paper	8.27	1.00	4.87	0.30	1.99	1.82	2.35	2.26
Boxboard	n.r.	3.47	n.r.	n.r.	4.63	4.26	5.48	5.26
OCC	9.94	2.08	14.63	6.63	2.50	3.05	3.44	3.57
Mixed Paper/Magazines	12.68	20.67	14.95	22.18	10.60	12.15	13.00	15.02
Glass	6.80	7.05	9.39	7.74	9.29	6.88	5.77	4.43
Plastic	5.08	7.31	4.99	9.73	8.30	6.53	9.52	7.78
Packaging	n.r.	n.r.	5.68	n.r.	n.r.	n.r.	n.r.	n.r.
Metals: non-ferrous	0.85	0.14	0.87	1.23	1.31	0.99	0.98	0.97
Tinplate Steel	5.58	6.49	2.18	5.22	5.20	3.74	4.22	3.38
White Goods	n.r.	n.r.	4.62	0.04	n.r.	n.r.	n.r.	n.r.
Rubber/Leather Textiles	3.71	n.r.	1.41	3.73	3.92	4.11	4.64	5.08
Food Waste	31.62	22.24	10.64	19.69	26.70	25.81	31.59	31.91
Wood Waste	3.51	1.38	n.r.	1.59	1.39	0.94	1.64	1.16
Construction/Demo.	1.86	n.r.	n.r.	9.14	1.65	1.62	1.95	1.99
Diapers	n.r.	n.r.	n.r.	3.00	4.01	2.65	4.74	3.27
Household Hazardous Waste	0.32	n.r.	n.r.	0.68	0.40	0.41	0.48	0.49
Other	0.00	11.47	18.00	0.52	3.17	1.93	3.75	2.39
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Overall Waste Generation Rate kg/cap/day	-	-	-	1.47	0.91	0.99	-	-

Notes:

- n.r. means that no waste was reported in that category.
- Yard wastes were not included in these calculations since Gore and Storrie did not report them. All other figures were adjusted accordingly.
- Franklin 1988 data includes light commercial waste as well as residential.

- There are some differences between Seattle data and the East York after recycling numbers. First, Seattle shows a high value for mixed paper and magazines composition (approximately 22% compared to East York 12%). Secondly, the reported construction and demolition materials (9% in Seattle, 2% in East York) are significantly different. A possible explanation is that the sampling in East York was done in the winter around Christmas time, which would decrease construction waste percentages, whereas Seattle gives an annual average, which may be more appropriate. However, differences in sorting strategies between the two studies may also play a role.

The range in values shown gives some indication of the variability associated with data from waste composition studies. It is important to recognize that although the final compositions arrived at for this study are reported to as many as four significant figures, the range in some of these figures may be quite significant.

The final residential waste composition values for 1987 and 1989 used for this study have been based largely on the Gore and Storrie data since this is the most recent study focused on sampling of the residential solid waste stream in Ontario. However, some of the numbers have been adjusted to account for factors not addressed in the Gore and Storrie methodology. For example, large items such as white goods were not collected in the Gore and Storrie study. The Gore and Storrie study eliminated items such as yard wastes which vary considerably on a seasonal basis. In addition, residential waste stream composition has changed slightly over the period 1987 to 1989 due to the introduction of aluminum beverage cans. Information from sources such as the other studies described above and information (made available to CH2M HILL by RIS who worked on a concurrent study) on production amounts were used to adjust the final compositions, as described in greater detail in Section 3.2.3.

Table 3.2 also presents reported residential waste generation rates from these studies which range from 0.91 to 1.47 kg/capita/day. Once again it is difficult to compare these figures since the various studies did not examine the same waste stream components. Further discussion of generation rates appears in Section 3.2.3.

Table 3.3 presents the final residential waste composition values used by the database to calculate amounts of various waste stream components produced by the residential sector in Ontario. The method used to arrive at these compositions is discussed in more detail in Section 3.2.3 since compositions were calculated when total provincial amounts of the various components were finalized.

Again, it must be pointed out that comparison to composition values presented in previous studies is limited by the fact that waste stream components are defined differently for each study. However, it is apparent that the composition values shown in Table 3.3 are in reasonable agreement with those presented in Table 3.2.

The task of developing residential solid waste generation rates for this study went through several iterations. The primary purpose of this subsection, then, is to summarize the final numbers arrived at, as well as to provide a brief history of the development of these figures referred to as the CH2M HILL initial estimate and the CH2M HILL final estimate in the following text. Any assumptions used in estimating quantities where actual data were unavailable are also outlined. A discussion of the accuracy of the data as well as comparison to other estimates concludes this subsection.

CH2M HILL Initial Estimate

An initial set of residential solid waste generation quantity estimates for 1987 were generated through the following approach. All available Waste Management Master Plans (WMMPs) were reviewed for data on per capita residential waste generation rates or total residential solid waste generation. This exercise yielded data for 52% of the province's population and 28% of all municipalities. All of these data were converted to per capita residential waste generation rates by applying the appropriate population for the year of the WMMP.

For the remainder of the municipalities, assumed generation rates based on the Gore and Storrie studies for Fergus and East York were applied. Thus it was possible to develop assumed generation rates which reflected differences for municipalities of greater than and less than 100,000 population, as well as for those conducting Blue Box recycling in 1987 and those who were not. Lower, "after-recycling" assumed generation rates were applied only for those counties where greater than 50% of single family homes were part of a Blue Box program in 1987. Since actual WMMP data were available for most of these communities, WMMP generation rates were applied.

The assumed generation rates as well as those developed from WMMP data were multiplied by 1987 population values to yield the estimates of 1987 residential waste quantities. This approach assumed that per capita generation rates remained constant from the time of the WMMPs to 1987. This assumption was considered reasonable since all WMMPs reviewed were published in the early- to late-1980s. Because the total quantities estimated by this method accounted for lower waste generation rates due to the presence of Blue Box programs, the resulting estimates reflected the amount of waste that was disposed (landfilled or incinerated) in 1987, rather than that which was actually generated. Because Blue Box recycling was not extensively implemented in Ontario in 1987, the quantity of waste generated by households would be similar to the quantity of waste disposed as the quantity of waste recycled by households was not a significant portion of the total waste stream. Using this method, it was estimated that 3,667,100 tonnes of MSW was disposed by households in Ontario in 1987. This estimate was subsequently revised as discussed in the next paragraph.

Table 3.3
ESTIMATED RESIDENTIAL WASTE COMPOSITION IN ONTARIO
IN 1987 AND 1989

Component	1987 Composition (%)	1989 Composition (%)
PAPER		
Newsprint	16.66	16.61
Fine Paper	1.83	1.83
Boxboard	4.29	4.27
OCC	2.70	2.69
Magazines	4.09	4.07
Mixed Paper (waxed/plastic/mixed)	1.47	1.46
Phone Books	0.32	0.32
Composite Packaging	0.28	0.28
Other (kraft, wallpaper, tissue)	4.85	4.84
Subtotal	36.49	36.37
GLASS		
Food/Beverage Containers	6.65	6.62
Other	0.56	0.56
Subtotal	7.21	7.18
TINPLATE STEEL		
Food/Beverage Containers	1.86	1.85
White Goods	2.51	2.50
Other	1.39	1.39
Subtotal	5.76	5.74
ALUMINUM		
Beverage Containers	0.00	0.33
Other Containers	0.26	0.26
Foil (rigid and flexible)	0.07	0.07
Other	0.11	0.11
Subtotal	0.44	0.77
PLASTIC		
PET	0.09	0.09
HDPE	0.28	0.28
Other Rigid	2.77	2.76
Film	3.09	3.08
Subtotal	6.24	6.22
ORGANICS		
Food Waste	15.46	15.41
Yard Waste (leaves, grass and weeds)	12.12	12.08
Yard Waste (other)	4.08	4.07
Subtotal	31.66	31.56

Table 3.3
ESTIMATED RESIDENTIAL WASTE COMPOSITION IN ONTARIO
IN 1987 AND 1989 (Cont'd)

Component	1987 Composition (%)	1989 Composition (%)
WOOD WASTE	1.16	1.15
CONSTRUCTION AND DEMOLITION		
Drywall	0.28	0.28
Other	1.29	1.29
Subtotal	1.57	1.57
DIAPERS	2.75	2.74
USED TIRES	0.02	0.02
HHW	0.58	0.58
OTHER	6.13	6.10
TOTAL	100.00	100.00
POPULATION	9,271,500	9,598,600
GENERATION RATE (kg/cap/year)	421	422

Sources:

1. Gore and Storrie Ltd. in association with Decima Research Ltd., 1990. Ontario Waste Composition Study. Report to the Ontario Ministry of the Environment.
2. Apotheker, S., 1989. Recycling Pathways for White Goods. Published in Resource Recycling, October, 1989.
3. Personal Communication with Resource Integration Systems (RIS) on production values for specific materials.
4. See Table 3.5 for explanation of some sources.

Table 3.4
ESTIMATED RESIDENTIAL WASTE GENERATION BY MATERIAL TYPE
IN ONTARIO IN 1987 AND 1989

Component	1987 Quantity (t/yr)	1989 Quantity (t/yr)
PAPER		
Newsprint	650,200	673,200
Fine Paper	71,500	74,000
Boxboard	167,200	173,100
OCC	105,200	108,900
Magazines	159,500	165,100
Mixed Paper (waxed/plastic/mixed)	57,300	59,300
Phone Books	12,600	13,000
Composite Packaging	11,000	11,400
Other (kraft, wallpaper, tissue)	189,300	196,000
Subtotal	1,423,800	1,474,000
GLASS		
Food/Beverage Containers	259,300	268,500
Other	21,900	22,700
Subtotal	281,200	291,200
TINPLATE STEEL		
Food/Beverage Containers	72,500	75,100
White Goods	97,900	101,400
Other	54,400	56,300
Subtotal	224,800	232,800
ALUMINUM		
Beverage Containers	0	13,500
Other Containers	10,000	10,400
Foil (rigid and flexible)	2,800	2,900
Other	4,200	4,300
Subtotal	17,000	31,100
PLASTIC		
PET	3,700	3,800
HDPE	11,100	11,500
Other Rigid	108,100	111,900
Film	120,700	125,000
Subtotal	243,600	252,200

Table 3.4
ESTIMATED RESIDENTIAL WASTE GENERATION BY MATERIAL TYPE
IN ONTARIO IN 1987 AND 1989 (Cont'd)

ORGANICS		
Food Waste	603,300	624,600
Yard Waste (leaves, grass and weeds)	472,800	489,500
Yard Waste (other)	159,300	164,900
Subtotal	1,235,400	1,279,000
WOOD WASTE	45,100	46,700
CONSTRUCTION AND DEMOLITION		
Drywall	11,100	11,500
Other	50,300	52,100
Subtotal	61,400	63,600
DIAPERS	107,200	111,000
USED TIRES	800	800
HHW	22,600	23,400
OTHER	239,000	247,400
TOTAL	3,901,900	4,053,200
POPULATION	9,271,500	9,598,600
GENERATION RATE (kg/cap/year)	421	422

Sources:

1. Gore and Storrie Ltd. in association with Decima Research Ltd., 1990. Ontario Waste Composition Study. Report to the Ontario Ministry of the Environment.
2. Apotheker, S., 1989. Recycling Pathways for White Goods. Published in Resource Recycling, October, 1989.
3. Personal Communication with Resource Integration Systems (RIS) on production values for specific materials.
4. See Table 3.5 for explanation of some sources.

CH2M HILL Final Estimate

The scope of the study was subsequently expanded to include 1989 estimates of residential solid waste generation in addition to 1987 estimates. In addition, more data were obtained on quantities of various waste stream components generated in the Province (e.g. white goods etc.). It was also considered more appropriate to estimate the total amount of waste generated by the residential sector prior to recycling activities, and then subtract the quantities of waste recycled from this total to estimate the amount of residential waste disposed in the Province. This approach involved a simpler computational exercise for the study database. A number of adjustments were made to the provincial totals for some waste components. The 1989 totals were developed in conjunction with the work of RIS in a concurrent study. The final estimated residential solid waste quantities generated by households in Ontario in 1987 and 1989 are presented by component in Table 3.4. A summary of changes, assumptions and important comments by component appears in Table 3.5. As shown in Table 3.4 it is estimated that 3,901,900 tonnes of MSW was produced by the residential sector in Ontario in 1987 and 4,053,200 tonnes were produced in 1989.

Table 3.4 also presents population data and the resulting per capita generation rate for 1987 and 1989. This study has no data to suggest that the per capita generation rate is changing. The assumption of constant per capita generation for a particular area over time was made in the use of WMMP data as noted above. Thus the difference between 1987 and 1989 generation rates of less than half of one percentage point is considered insignificant. The generation rate of 422 kg/capita/year estimated for Ontario using the methods described above, will be used throughout this and other concurrent studies.

Data from the Ministry of the Environment's Waste Management Branch have suggested that the provincial residential solid waste generation rate is 400 kg/capita/year. However, no data have been provided to CH2M HILL to substantiate this figure. This study's figure of 422 kg/capita/year is slightly more than 5% higher, but because it has been based on extensive review of municipal data and, for some components, review of consumption data, it is believed to be the most comprehensive figure available. Within the accuracy of the study the two values (400 and 422 kg/cap/day year) are considered to be essentially the same.

Table 3.6 presents estimated residential solid waste generation in Ontario in 1987 and 1989 on a county-specific basis. Population, estimated total waste generated and per capita generation rates are presented for both reported years in the table. Where available, actual per capita generation rates were used. If no data were available, a default generation rate of 371 kg/cap/year is applied. This was estimated by subtracting known county specific residential waste quantities and populations from provincial totals and dividing the remaining waste quantity by the remaining population. Per capita generation rates vary across the province, from a low of 228 kg/capita/year in Victoria County, to a high of 971 kg/capita/year in Niagara Region. No obvious reason for these wide ranges was identified during the present study.

Table 3.5
SUMMARY OF MODIFICATIONS TO RESIDENTIAL SOLID WASTE
QUANTITY ESTIMATES

Component	Basis Of Quantities (see notes)	Comments
Newsprint	a	
Fine Paper	a	
Boxboard	a	
OCC	a	
Magazines	a	
Mixed Paper	a	
Telephone Books	b	
Composite Packaging	a	This estimate a guess only; no data available.
Other Paper	a	
Glass Containers	a	The relative amounts in 1987 and 1989 of this item may not accurately reflect increasing displacement by plastic and aluminum since figures were adjusted by population only; no further data available.
Other Glass	a	
Tinplate Steel Containers	b	The relative amounts of this item for 1987 and 1989 may not accurately reflect increasing displacement by plastic and aluminum since figures were adjusted by population only; no further data available.
White Goods	c	
Other Tinplate Steel	a	
Aluminum Beverage Containers	d,e	This and following category created to bridge gap between RIS and CH2M HILL initial estimates.
Other Aluminum Containers	e	This and preceding category created to bridge gap between RIS and CH2M HILL initial estimates.
Aluminum Foil	f	
Other Aluminum	a	
PET	b	
HDPE	b	
Other Rigid Plastic	g	This and following category created to bridge gap between RIS and CH2M HILL initial estimates.
Film Plastic	g	This and preceding category created to bridge gap between RIS and CH2M HILL initial estimates.
Food Waste	b	
Yard Waste	h	
Other Yard Waste	h	

Table 3.5
SUMMARY OF MODIFICATIONS TO RESIDENTIAL SOLID WASTE
QUANTITY ESTIMATES

Component	Basis Of Quantities (see notes)	Comments
Wood Waste	b	
Drywall	b	
Other Construction and Demolition Waste	a	
Diapers	b	
Used Tires	b	
Household Hazardous Waste	a	
Other	a	

Notes:

- a 1987 quantity from CH2M HILL initial estimate; 1989 quantity obtained by adjusting for population increase (3.53%).
- b 1989 quantity from RIS initial estimate; 1987 quantity obtained by adjusting for lower population.
- c Generation rate obtained from Apotheker, 1989. Recycling Pathways for White Goods. Published in Resource Recycling, October 1989. 1987 and 1989 quantities obtained by applying 1987 and 1989 population.
- d 1987 quantity adjusted to zero since these items were not yet on the market; 1989 estimates from RIS.
- e 1987 total of these two categories, from CH2M HILL initial estimates, scaled to 1989; 1989 Other Container total by difference with Beverage Container total from RIS (Note d); 1987 Other Container total from scaling of 1989 Other Container total.
- f 1989 RIS quantity based on survey of production data; 1987 quantity obtained by adjusting for lower population.
- g 1989 RIS quantity based on survey of Society of Plastics Industries; 1987 quantity obtained by adjusting for lower population.
- h RIS initial estimate for these two categories divided according to the ratio of the 1987 CH2M HILL initial estimate; 1987 quantities obtained by adjusting for lower population.

Table 3.6
ESTIMATED RESIDENTIAL POPULATIONS, GENERATION RATES AND WASTE
QUANTITIES PRODUCED BY COUNTY IN ONTARIO, IN 1987 AND 1989

County	1987			1989		
	Population	Generation Rate (kg/cap/yr)	Total Quantity (t/yr)	Population	Generation Rate (kg/cap/yr)	Total Quantity (t/yr)
Metro Toronto	2,207,522	416	918,550	2,133,021	416	887,550
Durham	340,924	416	141,858	379,454	416	157,891
Haldimand-Norfolk	90,206	371	33,156	93,338	371	34,648
Halton	275,695	371	101,333	292,885	371	108,720
Hamilton-Whitby	428,894	337	144,720	445,546	337	150,339
Niagara	371,173	971	360,372	384,450	971	373,262
Ottawa	618,785	354	219,081	661,795	354	234,309
Peel	613,941	473	290,531	676,702	473	320,231
Sudbury (R.M.)	149,856	371	55,080	152,308	371	56,537
Waterloo	335,520	416	139,610	357,810	416	148,885
York	374,225	416	155,715	445,044	416	185,183
Muskoka	40,950	371	15,051	43,713	371	16,226
Brant	106,636	371	39,195	110,776	371	41,121
Bruce	59,174	371	21,750	66,853	371	24,816
Dufferin	33,117	442	14,626	35,149	442	15,524
Elgin	70,326	371	25,849	72,767	371	27,011
Essex	319,023	371	117,259	334,347	371	124,111
Frontenac	115,930	301	34,656	119,169	301	35,856
Grey	74,812	372	27,547	77,407	372	28,779
Haliburton	12,044	371	4,427	12,437	371	4,617
Hastings	110,420	371	40,585	113,192	371	42,017
Huron	55,847	402	22,423	57,394	402	23,044
Kent	107,140	371	39,380	111,522	371	41,398
Lambton	125,128	371	45,991	127,983	371	47,508
Lanark	47,961	394	18,906	50,853	394	20,046
Leeds & Grenville	85,510	753	64,288	90,055	753	67,824
Lennox & Addington	47,099	332	15,504	48,460	332	16,084
Middlesex	337,078	371	123,895	355,340	371	131,904
Northumberland	68,242	420	28,645	71,590	420	30,050
Oxford	84,887	371	31,201	86,795	371	32,219
Perth	66,450	351	23,085	68,876	351	24,164
Peterborough	105,463	371	38,763	109,558	371	40,668
Prescott-Russell	59,074	371	21,713	63,745	371	23,662
Prince Edward	22,367	371	8,221	23,008	371	8,541
Renfrew	92,764	463	42,791	92,355	463	42,781
Simcoe	265,225	381	100,450	249,269	381	94,993
Stormont-Glengarry	103,371	685	71,215	100,369	685	68,753
Victoria	53,611	228	12,212	57,335	228	13,060

Table 3.6
ESTIMATED RESIDENTIAL POPULATIONS, GENERATION RATES AND WASTE
QUANTITIES PRODUCED BY COUNTY IN ONTARIO, IN 1987 AND 1989

County	1987			1989		
	Population	Generation Rate (kg/cap/yr)	Total Quantity (t/yr)	Population	Generation Rate (kg/cap/yr)	Total Quantity (t/yr)
Wellington	141,422	371	51,980	149,947	371	55,661
Algoma	132,179	371	48,583	135,960	371	50,469
Cochrane	94,207	371	34,626	99,608	371	36,975
Kenora	59,678	371	21,935	62,420	371	23,171
Manitowlin	10,308	371	3,789	10,519	371	3,905
Nipissing	78,799	371	28,963	80,896	371	30,029
Parry Sound	33,996	371	12,495	34,823	371	12,926
Rainy River	22,944	371	8,433	23,744	371	8,814
Sudbury District	25,393	371	9,333	25,428	371	9,439
Thunder Bay	156,206	371	57,414	161,954	371	60,118
Timiskaming	39,973	371	14,692	40,626	371	15,081
Total or Average	9271500	421	3,901,900	9,598,600	422	4,053,200

Notes:

*Figures rounded in agreement with Table 3.4, and may not add exactly.

Where a value of 371 kg/cap/year appears, this is a default value used when actual data are not available.

3.3 INDUSTRIAL/COMMERCIAL/INSTITUTIONAL SOLID WASTE

3.3.1 Materials Excluded From Estimates

It is important to note that **several large volume ICI residuals** were not specifically considered in this study. These include solid wastes from:

- construction/demolition not disposed in public landfills
- decommissioning and clean-up of spills and contaminated soils
- road construction and maintenance
- dredging of waterbodies

In addition, the following materials were not considered in this study:

- foundry sand
- blast furnace slag
- fly ash
- bottom ash
- compost
- sewage sludge.

The focus of the present study was ICI waste that is disposed at non-hazardous waste landfills and incinerators. Waste composition data and waste quantity estimates are described in the following Sections.

3.3.2 Objectives of ICI Waste Generation Estimates

To be of maximum benefit to subsequent studies, the data generated by CH2M HILL on ICI waste had to include the following factors:

- ICI generation by waste type.
- ICI generation by industry (IMC) type.
- ICI generation by county.

It was determined that the best way to generate these estimates was to set up a model which took all of these factors into account. The following sections describe how the model was developed, and the preliminary data generated by the model. It should be stressed that the CH2M HILL/ERL model contains information available at the time of the study and that it can be updated as more information becomes available.

This study includes an ambitious effort to develop estimates of Industrial/Commercial/Institutional (ICI) solid waste generation in Ontario. As noted in Section 2, sources of data on ICI solid waste quantities and composition are scanty at best and so a method of estimation based on primary data collection, rather than secondary data sources was developed. It was determined that in order to meet the needs of concurrent economic studies, the estimation method would incorporate the economic sectors developed by ERL (Econometric Research Limited). The ERL model involves 25 sectors, known as Input Matrix Categories (IMCs), covering all SIC groups, as described in Table 3.7.

An **ICI waste composition database** was developed for this study primarily using data from surveying and auditing activities at 180 companies in the Essex-Windsor area. This was supplemented where necessary (i.e. where less than five data sets were available for a particular IMC) by data obtained from the City of Cornwall and in some cases from studies carried out in Seattle, Washington, and Brattleboro, Vermont. Data on employment and quantities of various waste components produced by each company were entered in the appropriate IMC waste composition file. IMC-specific average waste compositions and per employee generation rates were calculated from the data available. The results of this exercise (which went through a number of iterations described in Section 3.3.4) are presented in Table 3.8.

Several points regarding these data are worth noting. Data from four studies contributed to the IMC-specific data. This limits the coverage of some geographical and economic areas of the province. For example, data on IMC 2, Mining, were unavailable since the available survey data did not cover Northern Ontario. (In the case of IMC 2, Mining, this is not considered a serious limitation as the process itself does not generate quantities of material which are disposed at municipal landfills.)

For each IMC, the total amount of waste reported by all companies in the database was divided by the total number of employees reported for all the companies in the database to estimate an average per employee generation rate for the IMC. In some IMCs, data on a few firms appeared out of line with the remaining data. In many of these cases, some explanation could be found relating to the activities of the firm, and such outliers were deleted using professional judgement.

It should also be noted that while composition and generation rates for most IMCs were based on data from at least five firms, those firms did not necessarily represent the full range of activity in that sector. For example, data on IMC 1, Agriculture, are concentrated on greenhouses, rather than on farming or forestry activities. However, these data remain the most comprehensive available at the time of report preparation.

Table 3.7
AGGREGATION OF INDUSTRIAL/COMMERCIAL/INSTITUTIONAL
ACTIVITIES INTO 25 INPUT MATRIX CATEGORIES (IMC'S)

Input Matrix Category (IMC) Number	Description	Canadian 2 Digit Major SIC Categories Included
1.	Agriculture: agriculture forestry fishing, hunting and trapping	01,02 04,05 03
2.	Mining: metal mines mineral fuels non-metal mines services incidental to mining	06 07 08 09
3.	Food and Beverage Industries	10, 11
4.	Rubber, Plastic and Leather Industries	15 - 17
5.	Textile, Knitting Mills and Clothing Industries	18, 19, 24
6.	Wood Industries	25
7.	Furniture and Fixtures Industries	26
8.	Paper and Allied Industries	27
9.	Printing and Publishing Industries	28
10.	Primary Metal Industries	29
11.	Metal Fabricating Industries	30
12.	Machinery Industries	31
13.	Transportation Industries	32
14.	Electrical Products Industries	33
15.	Non-metallic Mineral Products Industries	35
16.	Chemical and Chemical Products Industries	37
17.	Miscellaneous Manufacturing Industries	39
18.	Other Major Manufacturing Industries: tobacco products industries petroleum and coal products industries	12 36
19.	Wholesale Trade Margins	50 - 59

Table 3.7
AGGREGATION OF INDUSTRIAL/COMMERCIAL/INSTITUTIONAL
ACTIVITIES INTO 25 INPUT MATRIX CATEGORIES (IMC'S)

Input Matrix Category (IMC) Number	Description	Canadian 2 Digit Major SIC Categories Included
20.	Construction	40 - 44
21.	Transportation Margins	45 - 47
22.	Communications and Services:	
	communications	48
	owner occupied dwellings	
	finance, ins., and real estate	70 - 76
	education and health services	85, 86
	services to business management	77
	personal and misc. services	97
	amusement and recreation services	96
	accommodation and food services	91, 92
23.	Electrical Power and Gas	49
24.	Retail Trade Margins	60 -65, 69
25.	*Other Sources:	
	operating office, lab, and food	81 - 84
	travel, promotion and advertising	98, 99

* IMC 25 contains SICs not accounted for in other IMCs, namely:

IC	81 -	Federal Government Service Industries
SIC	82 -	Provincial and Territorial Government Industries
SIC	83 -	Local Government Service Industries
SIC	84 -	International and Other Extraterritorial Government Service Industries
SIC	98 -	Member Organization Industries
SIC	99 -	Other Service Industries

Table 3.8
SUMMARY OF AVAILABLE INFORMATION ON WASTE COMPOSITION AND GENERATION RATES
BY INDUSTRIAL SECTOR IN ONTARIO

IMC Category	Reported Waste Composition (%)										Generation Rates (kg/emp/day)		Modified Median (a)
	OCC	Office Paper	Other Paper	Wood	Glass	Plastic	Organics	Metal	Tires	Other	Median	Average	
1	32.3	0.0	11.5	47.2	0	0	0	0	0	9.0	2.74	13.25	1.63
2	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
3	4.4	0.8	3.7	2.0	8.6	2.0	60.6	5.1	0	12.8	11.96	15.41	14.98
4	9.6	0.7	1.4	18.1	0	18.8	0	5.8	31.4	14.3	4	7.22	7.15
5	1.0	0.4	18.1	1.7	0	8.8	0	1.3	0	68.8	1.62	1.69	1.66
6	3.5	0	0	65.8	0.1	5.7	0	1.5	0	23.4	4.48	4.72	4.4
7	6.7	0.8	0	15.2	0	0	0	6.0	0	71.3	2.51	9.63	8.45
8	6.5	13.2	0	39	0	0.2	13.4	20.8	0	6.8	5.25	5.50	5.13
9	1.8	5.1	81.8	2.7	0	0.2	0	0.2	0	8.2	1.19	2.02	1.95
10	5.6	0.1	17.3	52.0	0	0	0	1.6	0	23.4	2.86	15.07	5.84
11	4.6	0.1	11.5	11.7	0	1.1	0	48.5	0	22.5	2.83	6.52	5.94
12	5.4	0.2	1.3	11.4	0	3.5	2.7	23.9	0	51.6	1.37	3.53	3.21
13	4.7	0.5	1.4	12.0	0.4	0	0.2	29.3	0	51.4	2.35	6.53	5.95
14	12.3	2.6	33.2	38.8	0	4.1	0	7.5	0	1.5	4.48	3.97	3.16
15	1.7	4.0	0	3.5	0	0	0	65.4	0	25.4	6.83	7.74	7.47
16	47.7	1.6	11.4	1.4	3.0	8.9	0.2	5.0	0	20.7	3.90	6.57	3.29
17	18.5	0.7	31.4	6.5	1.2	0.8	0	21.0	0	19.8	1.64	1.33	0.96
18	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
19	49.7	0	4.4	32.4	0	13.5	0	0	0	0	2.25	4.03	1.62
20	1.8	1.0	0	44.7	0	0.5	1.9	9.0	0	41.1	(b)	29.86	29
21	9.2	85.0	0	5.8	0	0	0	0	0	0	2.08	2.08	1.72
22	9.0	12.9	19.8	5.9	20.8	4.2	7.1	10.4	0.1	10.0	2.11	2.65	2.3
23	13.6	40.5	0	0	0	0	0	5.9	0	40.0	1.67	2.02	1.6
24	17.5	30.1	1.5	8.8	0.2	6.6	42.9	4.8	9.4	5.3	2.68	2.58	3
25	4.6	13.7	35.4	1.8	0.2	9.0	0.4	17.6	0	17.4	0.60	1.19	1.09

Notes:

Nd indicates no data available.

These compositions and generation rates were developed from raw data provided by studies in Essex-Windsor, (180 data sets) Cornwall, Seattle, Washington, and Brattleboro, Vermont, as noted in Section 3.3.1.

(a) Median and average values were calculated from original data. Modified median values were calculated when provincial estimates were revised.

(b) Average value not calculated for construction industry. Metro Toronto data used to calculate medians.

The waste categories for this database are the same as those used by Essex-Windsor, namely:

- OCC
- Fine paper
- Other paper
- Wood
- Glass
- Plastic
- Organics
- Metal
- Tires
- Clean Fill
- Garbage
- Other

Quantities of unsorted garbage (ie, waste components not identified) made up a large part of the data. This "garbage" quantity was redistributed in the various categories in proportion to the reported composition of the sorted waste stream. In addition, many of the components listed did not correspond to those of interest to this study. For example, metals were not differentiated by type. Unfortunately, this is a limitation of the available data. The category "Clean Fill" was deleted, because no data were reported.

The category "other" has been retained. The form of the raw data suggested that quantities in the "other" category were actually segregated, potentially recyclable items and not just "garbage". It was felt that this information, though limited, should not be discarded.

3.3.4 ICI Waste Quantity Estimates

Once per employee generation rates were developed for each IMC as described in the previous subsection, data on employment could be used to estimate total ICI waste produced in the province. This was accomplished by providing IMC employee generation rates to ERL, who used confidential provincial and county employment data to estimate ICI waste quantity production. The ICI estimate took place through a series of steps, described below.

The calculation was first performed on the provincial level in order to ascertain whether the method yielded reasonable figures. This involved a number of iterations to arrive at a reasonable provincial total quantity. When a reasonable provincial total was established, estimation of ICI waste generation on the county level took place. This permitted the comparison of estimates generated by the model to the limited data on total ICI quantities obtained from the review of Waste Management Master Plans (WMMPs). As noted in Section 3.3.1, per employee generation rates have a number of uncertainties associated with them, including: limited sampling of the range of activities

in some IMCs; deletion of outlying data points; and limited geographical area of sampling. Since those data available from WMMPs were likely more reliable, they were used to adjust model estimates in the database.

The means used to adjust the WMMP data for inclusion in the model are as follows:

1. The WMMPs did not always account for 100% of a county's population. WMMP ICI waste quantities were scaled proportionally to population to give estimates for the entire county.
2. Ten percent annual increases in ICI waste quantities were assumed to scale WMMP quantities from the year of the WMMP to 1987 and 1989. This assumption was considered reasonable, as the time period in question (mid to late 1980's) was one of economic prosperity.

In some cases, county-specific information on industrial sectors was used to adjust employee generation rates. For example, data on the construction sector in Metro Toronto was used to adjust generation rates for IMC 20.

Once the total ICI waste generation figure for each county was finalized (using either model or WMMP data), the Provincial total ICI waste quantity and total quantities, of material in each of the waste categories were re-calculated. For some waste quantities (specifically OCC, organics and tires), the calculated totals were adjusted using reported data from other sources. As an example, the ICI waste model calculated a total OCC value which was greater than the estimated quantity of OCC used in Ontario in 1989, as reported by RIS. In this case the CH2M HILL/ERL model values for generation by IMC group were adjusted to reflect the estimated Provincial OCC generation of 441,000 tonnes.

A similar exercise was carried out for organics and used tires. The total quantity of organic waste produced by the ICI sector was estimated at 600,000 tonnes, based on data from a study of municipal solid waste generated in Seattle, Washington. The total quantity of used tires generated by the ICI sector was obtained from a study by Pilonusso. Waste generation rates and waste composition for each IMC were adjusted accordingly. The final adjusted waste generation rates and waste composition values used to estimate ICI waste generation in Ontario are presented in Table 3.8.

The method described above yielded an estimate of about 5,361,000 tonnes of ICI waste produced in the province in 1989. The final provincial ICI waste estimate for 1989 was used to provide a 1987 total using confidential employment data from ERL and the generation rates presented in Table 3.8. The two estimates do not take changes in waste generation and disposal practices between 1987 and 1989 into account.

The estimated breakdown of material types generated by the ICI sector in the province in both 1987 and 1989 are presented in Table 3.9. These data were generated by the CH2M HILL/ERL model with detailed industry specific waste generation and employment data. They are compared to independent estimates developed by RIS in a concurrent study in Section 3.3.5.

Table 3.9
ESTIMATED ICI WASTE QUANTITIES GENERATED IN
ONTARIO BY WASTE COMPONENT IN 1987 AND 1989
(CH2M HILL/ERL MODEL)

Component	Estimated Quantity Generated (tonnes)	
	1987	1989
OCC	450,000	441,000
Office Paper	345,000	354,000
Other Paper	424,000	426,000
Wood	1,114,000	1,130,000
Glass	279,000	282,000
Plastic	167,000	163,000
Organics	568,000	600,000
Metal	558,000	599,000
Tires	82,000	88,000
Other	1,202,000	1,278,000
Total	5,189,000	5,361,000
Note: Total ICI waste quantities were developed by ERL Ltd. by multiplying the generation rates of Table 3.8 by employment data. Quantities of individual waste components were then calculated using the composition presented in Table 3.8		

Table 3.10 presents ICI solid waste quantity estimates by county, and Table 3.11 presents estimated quantities generated by IMC. Note in Table 3.11 that some IMCs have been combined for 1987. Thus, direct comparison of 1987 and 1989 figures for these IMCs may be misleading. The affected IMCs are 19 and 24 (combined in 1987; separated for 1989) and IMC'S 21 and 23.

The MOE developed a preliminary estimate of 550 kg/capita/year for ICI waste generation. The per capita figures generated by various counties in the present study varied from a low of 206 kg/capita/year in Lennox and Addington in 1989, to a high of 699 kg/capita/year in Hamilton-Wentworth in 1987. It would appear reasonable that rates would vary across the province depending on the nature of economic activity in the various areas. Based on total ICI generation of about 5,189,000 tonnes and a provincial population of 9,271,500 in 1987, the overall provincial generation rate is estimated

Table 3.10
ESTIMATED ICI WASTE QUANTITIES GENERATED BY
COUNTY IN ONTARIO, 1987 AND 1989

County	1987			1989		
	Quantity	Population	Gen. Rate (kg/cap/yr)	Quantity	Population	Gen. Rate (kg/cap/yr)
Algoma	58,392	132,179	442	59,849	135,960	440
Hastings/Prince Edward	71,936	132,787	480	73,512	136,200	458
Brant	50,629	106,636	475	51,216	110,776	462
Leeds & Grenville (Brockville)	38,580	85,510	451	38,961	90,055	433
Bruce	25,416	59,174	430	26,123	66,853	391
Northumberland (Cobourg)	30,063	68,242	441	30,663	71,590	428
Cochrane	35,205	94,207	374	35,001	99,608	351
Dufferin	12,603	33,117	381	12,840	35,149	365
Stormont-Glenarry (Dundas)	52,721	103,371	510	53,953	100,369	538
Elgin	20,344	70,326	289	20,580	72,767	283
Essex	212,114	319,023	665	216,777	334,347	648
Grey	32,865	74,812	439	33,416	77,407	432
Haldimand-Norfolk	44,541	90,206	494	46,289	93,338	496
Haliburton	4,311	12,044	358	4,377	12,437	352
Hamilton-Wentworth	299,642	428,894	699	307,248	445,546	690
Huron	24,770	55,847	444	25,456	57,394	444
Kenora & Rainy River	25,964	82,622	314	25,898	86,164	301
Kent	59,356	107,140	554	61,380	111,522	550
Frontenac (Kingston)	77,480	115,930	668	77,780	119,169	653
Lambton	58,030	125,128	464	60,230	127,983	471
Lanark	19,072	47,961	398	19,485	50,853	383
Lennox & Addington	9,913	47,099	210	9,993	48,460	206
Middlesex (London)	196,574	337,078	583	199,382	355,340	561
Manitowlin	2,891	10,308	280	2,926	10,519	278
Muskoka	12,640	40,950	309	12,624	43,713	289
Nipissing (North Bay)	29,448	78,799	374	29,574	80,896	366
Durham (Oshawa)	143,820	340,924	422	191,671	379,454	505
Ottawa-Carleton	299,891	618,785	485	299,442	661,795	452
Oxford	40,365	84,887	476	41,299	86,795	476
Perry Sound	9,523	33,996	280	9,552	34,823	274
Perth	43,900	66,450	661	45,365	68,876	659
Peterborough	38,850	105,463	368	39,172	109,558	358
Prescott-Russell	18,309	59,074	310	18,550	63,745	291
Reafrew	31,754	92,764	342	32,151	92,355	348
Simcoe	95,327	265,225	359	96,556	249,269	387
Niagara (St. Catharines)	214,716	371,173	578	217,358	384,450	565
Sudbury (R.M. & Dist.)	82,049	175,249	468	82,853	177,736	466
Thunder Bay	74,121	156,206	475	73,942	161,954	457
Timiskaming	14,242	39,973	356	14,340	40,626	353
G.T.A. (Metro, Halton, Peel, York)	2,264,322	3,471,383	652	2,345,564	3,547,652	661
Victoria	21,781	53,611	406	22,160	57,335	387
Waterloo	221,364	335,520	660	225,123	357,810	629
Wellington	68,685	141,422	486	70,467	149,947	470
Total	5,188,519	9,271,495	560	5,361,098	9,598,595	559

Note

ICI waste quantities by county were developed by ERL Ltd. by multiplying the employee generation rates of Table 3.8 by data on employment by county.

Table 3.11
ESTIMATED ICI WASTE QUANTITIES GENERATED IN ONTARIO
BY IMC CATEGORY IN 1987 AND 1989

IMC Category	Estimated Waste Generated (tonnes)	
	1987	1989
1	62,000	75,000
2	nd	nd
3	440,000	468,000
4	135,000	135,000
5	35,000	38,000
6	27,000	25,000
7	73,000	74,000
8	80,000	80,000
9	38,000	42,000
10	130,000	139,000
11	148,000	171,000
12	50,000	49,000
13	250,000	255,000
14	82,000	81,000
15	60,000	59,000
16	66,000	61,000
17	30,000	34,000
18	nd	nd
19	169,000	166,000
20	1,487,000	1,601,000
21	139,000	134,000
22	1,140,000	1,155,000
23	33,000	28,000
24	417,000	397,000
25	97,000	94,000
Total	5,189,000	5,361,000

Notes:

1. "nd" indicates no data available
2. Estimates of ICI waste quantities by IMC were development by ERL Ltd. by multiplying the generation rates of Table 3.8 by employment in each IMC.
3. Totals are rounded to the nearest 1,000 tonnes.

at 560 kg/capita/year. For 1989, the average generation rate was calculated at 559 kg/capita/year. These values compare favourably to the MOE (1987) estimate of 550 kg/capita/year. It is not surprising that generation rates based on total population vary from year to year, since the size of the work force, and its distribution among IMCs is constantly changing. These estimates are based on a sound model of the relationship between economic activity and waste generation, as well as the best available data from surveys, and provide the detailed breakdowns by county, industry and waste type required to carry out the econometric analysis in concurrent studies.

It should be stressed that this is the first time that an effort has been made to generate this type of information for Ontario and the estimates presented are subject to the limitations described throughout the text. Many municipalities are now embarking on waste audits and waste composition studies. When the results of these studies are available, the CH2M HILL database can be updated and expanded and more accurate, up to date numbers can be developed. In the meantime, the estimate generated can be used for planning purposes.

3.3.5 Comparison of CH2M HILL/ERL Model Estimates with RIS Estimates

RIS developed estimates of various waste materials generated by the ICI sector as part of a concurrent study. These estimates are compared to the CH2M HILL/ERL model output in Table 3.12. The methodology used to develop the RIS estimates is outlined in *Market Assessment of 3R's Activities in Ontario, Report to MOE Policy and Planning Branch, 1991*. The total quantity of identified ICI waste in the RIS study was approximately 4,560,000 tonnes, based on 1989 data. The total waste which could be assigned to specific waste categories in the CH2M HILL/ERL model output was 4,083,000 tonnes, with or additional 1,278,000 tonnes in the "other" category. Direct comparison of the two estimates is limited by the fact that waste categories used in the two studies differ. The data provided by Essex Windsor had three paper products categories (OCC, fine paper, other paper) whereas the RIS study had seven (7) paper categories (old newspaper, fine paper, mixed paper, boxboard, OCC, magazines and telephones directories). The CH2M HILL/ERL model estimated a high generation rate for "metals" whereas RIS focused on data for two specific types of (recyclable) metal waste, namely tinplate steel cans and aluminum used beverage cans and foil.

The CH2M HILL/ERL model did not contain categories for drywall and foundry sand, both of which were included in the RIS study because of recyclability. The "other" category in the CH2M HILL/ERL estimate contains many of the materials estimated separately by RIS, and was retained in the model for this reason. The two sources provide a valuable first step in estimating ICI waste composition in Ontario.

Table 3.12
COMPARISON OF CH2M HILL/ERL AND
RIS ICI WASTE QUANTITY ESTIMATES

Material	CH2M HILL/ERL Estimate (tonnes)	RIS Estimate (tonnes)	RIS Reference Chapter	RIS Rationale
ONP	None	206,700	3	3.48% of ICI waste stream (Seattle data).
Fine Paper	Different categories used. Office paper 354,000 tonnes, other paper 476,000 tonnes.	510,800	4	CPPA fine paper usage in Canada x 37%, subtract Residential to get ICI.
Mixed Paper	Category not used. Total for office paper and other paper = 780,000 tonnes	513,300	5	8.64% of ICI waste stream (Seattle data)
Boxboard	Category not in CH2M HILL. May have been included in OCC estimates	196,200	5	37% of CPPA figure for boxboard usage in Canada, less Residential usage.
OCC	441,000	441,000	6	CPPA, OCC usage for Canada x 37%.
Magazines	No category	97,500	7	Based on circulation of 195 m magazines @ 0.5 kg/magazine.
Telephone Directories	No category	4,100	8	Bell Canada total 17,200 tonnes minus Residential sector.
Plastics	163,000	102,309	9	RIS analysis, certain categories only.
Container Glass	282,000	117,200	10	2.22% of ICI total (Seattle data).
Tinplate Steel Cans	No category-assume included in metals	28,508	11	0.54% of ICI total (Seattle data).
Aluminum	No category-assume included in metals	10,312 UBC 1,300 foil	12	Alcan data
Organics	600,000	600,000	13	Used CH2M HILL, based on Seattle data.
Disposal Diapers	No category	8,000	14	Pollution Probe gen. rate x 222 hospitals.
Wood Waste	1,130,000	1,129,800	15	Used CH2M HILL
Drywall	No category	104,000	16	Seattle (1.97% of ICI)
Scrap Tires	88,200	88,200	17	Inventory by Pilonosso
Foundry Sand	No category - not within the scope of this study	400,000	18	MITT
Other	1,278,000	No category		CH2M HILL "other" category covers materials not described in detail elsewhere.
Total	5,361,000	4,559,229		

3.4 RESIDENTIAL WASTE RECYCLED

3.4.1 Background

Prior to the Blue Box program, residential recycling programs lacked structure and effectiveness in collection and processing of recyclable materials. Recycling programs were characterized by payback centres, operated by business entrepreneurs, and depots, operated by municipalities or non-profit organizations. Generally, opportunities to participate in recycling fluctuated with market demand for the material. As virgin materials entered periods of temporary short supply, manufacturing industries would turn to secondary materials as a means of augmenting material input demands. Rising prices for secondary materials provided individuals or groups with the impetus to start up local payback centres. Unfortunately, the instability of the supply and demand market for secondary resources transferred over to the recycling centres. When demand for secondary materials decreased, accompanied by declining prices, the payback centres would disappear. This situation played havoc with the recycling market and perpetuated the state of insecurity and instability.

Throughout the 1970s and the early 1980s, recycling programs were characterized as single-material programs featuring one of three collection techniques:

- **Buy-Back Centres** - These centres provide financial incentives for consumers to separate their recyclable wastes and sell them to recycling program operators. Program operators acted as middlemen, purchasing the recycled material from the consumer at a discounted rate and then selling the secondary materials to end-users for a higher price.
- **Drop-off Centres** - Depots work on the principal of participants bringing their recyclable wastes to an unmanned structure with separate compartments for the respective materials. Often these depots are dispersed in central locations throughout an urban area or at the landfill site or transfer station in rural areas.
- **Curbside collection** - Early initiatives focused on the occasional curbside collection of single materials, primarily old newspapers and yard waste.

For municipalities to embark on a full-scale curbside program, it was essential for the recycling markets to commit to a guaranteed pricing schedule and continued demand for secondary materials. In 1983, the City of Kitchener secured a commitment from Quebec and Ontario Paper Company to accept all of its recycled newspapers. Upon attainment of this commitment, a full-scale curbside recycling program was launched. Containers used to collect the recyclable materials consisted of blue plastic boxes - alias the Blue Box program.

Today, municipalities offer a multitude of recycling programs, ranging from curbside collection programs to depot programs. Programs are characterized according to the following classifications:

- Class 1 - A multi-material curbside program involving the collection of at least newspaper, glass, and cans in an issued container with weekly collection usually on the same day as garbage day.
- Class 2 - Multi-material collection on the same day as garbage day but not involving an issued container.
- Class 3 - Curbside collection of newspaper only.
- Class 4 - Depot collection of more than one material.
- Class 5 - Depot collection of newspaper only.

In addition, municipalities have begun offering limited services to multi-unit residential buildings and rural areas. The majority of curbside recycling programs in operation target single family dwellings in urban environments.

In order to receive funding from the Ministry of the Environment and OMMRI, municipalities must ensure that the curbside collection program (Class 1) permits residents to recycle newspaper, glass, steel and aluminum. Although the collection of PET (polyethylene terephthalate) containers is optional, the majority of programs (with the exception of Ottawa/Carleton) offer collection.

As markets develop, programs can be expanded to include less traditional recyclable materials. Today, pilot projects are targeting magazines, boxboard, plastic film, and even disposable diapers. These and other trends will be further explored in Section 5.1.4 - Future Trends.

3.4.2 Data Manipulation

Recycling quantities generated in 1987 and 1989 were obtained from a variety of documents. Recycling numbers for 1987 were extracted from the RCO report and have been deemed highly accurate and therefore required minimal manipulation.

Failing to secure a comprehensive source for 1989 data, a combination of sources was used and a strategy was devised to determine the amount of Blue Box materials (newspaper, glass, steel, aluminum and PET) generated by each program operating in Ontario. In general, the amount of material recovered through each Blue Box was multiplied by the number of households served in each Blue Box program. OMMRI has produced a table of municipalities engaged in the Blue Box program from 1983 to the end of 1989. The total number of single-family households served by the curbside

program is calculated in the table. A comparison of sources helped to determine the amount of material recovered by each Blue Box, which is presented in Table 3.13. The variations in quantities reported for various materials are discussed below.

Table 3.13
COMPARISON OF ESTIMATES OF MATERIAL
RECOVERED PER BLUE BOX IN 1989

Material	MOE (kg/Blue Box/yr)	OMMRI (kg/Blue Box/yr)	RIS (kg/Blue Box/yr)	Calculated 1989 Blue Box Recovery Rate* (kg/Blue Box/yr)
Newspaper	104.00	104.00	104.33	87.00
Glass	21.00	20.00	18.00	17.50
Steel	10.50	10.50	9.50	9.50
Aluminum	--	0.90	2.04	1.80
PET	0.50	0.45	0.29	0.29

* The recovery rate was calculated by dividing the market number by the total number of blue boxes (1,792,000) used in Ontario as reported by OMMRI in 1989.

Sources: MOE Closing the Loop - the 3R's of Waste Management, 1990.
OMMRI Databank Information Sheets, March 1990.
RIS Market Assessment of 3R's Activities in Ontario, 1991.

Newspapers

There is some variation in the reported quantity of newspaper recovered by households through the Blue Box program annually. Depending on the source, the reported figures range from a low of 87 kg/Blue Box/yr to 104 kg/Blue Box/yr. Both OMMRI and the Ministry of the Environment (MOE) cite the figure as 104 kg/Blue Box/year. However, RIS report that in 1989 the end user market collected 155,500 tonnes of old newspapers from municipal programs in Ontario. When divided by the number of households served by the Blue Box program in 1989 (1,792,000), the quantity recovered per Blue Box is estimated at 87 kg/Blue Box/yr. This estimate was used for the present study as the total tonnage of materials cited in the RIS report was acquired through personal communications with the newspaper recycling end users, which are considered the most reliable source for this data.

Aluminum

Documents have reported conflicting figures relating to the quantity of aluminium recovered by the Blue Box program on an annual basis. According to the RIS report, households discard 2.04 kg of aluminum material into their Blue Box annually. However, the aluminum market accepted 3,225 tonnes of aluminum in 1989, some of which originated from ICI recycling programs initiated by Alcan. Using the market number and applying it to the total number of households served by the Blue Box program in 1989, results in an estimated 1.8 kg of aluminum recovered per Blue Box per year. Since some of the materials have been sourced as coming from the ICI sector, the OMMRI cited number of 0.9 kg/Blue Box/yr appears most appropriate for use in the database developed as part of the present study.

Glass, Steel, PET

The quantities reported by the previously documented sources are in reasonable agreement with respect to the quantity of glass, tin and PET collected through each Blue Box on an annual basis. The numbers cited by OMMRI, MOE and RIS are within the following ranges:

- glass - 18-21 kg/Blue Box/yr;
- steel - 9.5-10.5 kg/Blue Box/yr; and
- PET - 0.29-0.50 kg/Blue Box yr.

To remain consistent with RIS, the numbers provided in the RIS report were chosen for use in the study database. RIS reports the quantities as: glass - 18 kg/Blue Box/yr, steel - 9.5 kg/Blue Box/yr and PET - 0.29 kg/Blue Box/yr.

3.4.3

Quantities of Residential Waste Recycled

Table 3.14 summarizes the amount of recycled materials generated through the residential sector in Ontario in 1987 and 1989. The quantity of secondary materials recovered from the recycling program in 1987 amounted to 97,000 tonnes. These figures are based on the numbers recorded in the RCO report and as discussed previously, there is no reason to question their integrity.

In 1989, a total of 206,403 tonnes of recycled materials were collected through the Blue Box programs in Ontario (Municipal Recycling Support Program, MOE, 1989). The quantities calculated in the study database exceed the total amount reported in the MRSP program; the program reports the provincial total as 94,562 tonnes (refer to Table 3.15). The dichotomy between the two set of numbers can be explained by the fact that the MRSP program records only those figures reported by the municipalities. In 1989, a number of relevant contributors, namely Metropolitan Toronto, did not submit annual reports to the Ministry of the Environment. According to the SWISC

report, Metropolitan Toronto alone generated over 50,000 tonnes of secondary materials. This figure is not recorded in the 1989 MRSP report. Unfortunately, there is no dependable way to verify the numbers generated in the study database except to say that the provincial totals are based on the total amount of Blue Box materials reported by the end-user market.

Table 3.16 summarizes the study findings regarding residential solid waste recycling. The total quantity of residential solid waste generated in 1987 is estimated at 3,901,900 tonnes. The quantity of residential solid waste recycled in 1987 was reported as 97,000 tonnes by RCO (1987). Therefore, approximately 2.5% of the total residential solid waste stream was recycled in 1987. In 1989, total residential solid waste generation is estimated at 4,053,200 tonnes. An estimated 206,403 tonnes, or 5.1% of the residential waste stream was recycled. The net result is that an estimated 3,804,900 tonnes of residential solid waste was disposed in landfills/incinerators in 1987, and 3,846,800 tonnes was disposed in 1989.

3.5 ICI WASTE RECYCLED

3.5.1 Background

To date, much of the attention placed on recycling activities has been directed at the residential sector. With the Blue Box program securely in place, focus is being turned toward the ICI sectors (industrial, commercial, institutional).

The ICI sectors contribute large quantities of waste materials to Ontario's total solid waste stream. There exists enormous recycling potential since much of the waste stream is comprised of large volumes of recyclable materials which can be readily segregated. According to the Recycling Council of Ontario, corrugated cardboard represents 40% of the total waste materials generated by shopping malls and retail stores. Other materials such as fine paper and glass materials also contribute significant amounts to the solid waste stream generated by the ICI sector.

The ICI sector is being given a number of incentives to start incorporating 3R activities in their solid waste management strategies. In some cases, the driving force is legislative, for instance when municipal bylaws mandate landfill disposal bans on certain recyclable materials. In other cases, the driving force is economics in which savings are made through reduced tipping fee costs and sales of materials to secondary recycling markets.

Municipalities have begun targeting the ICI's most conspicuous wastes by imposing bans on specific materials entering landfills. Many larger municipalities, including Metropolitan Toronto, Peel, Halton and Durham, have introduced bans on corrugated cardboard, tires and wood wastes; and in some cases, have accepted responsibility for providing alternative markets for the materials. Table 3.17 identifies those bans placed on waste materials entering municipal landfills for the Greater Toronto Area.

Table 3.14
MATERIALS RECOVERED IN THE RESIDENTIAL SECTOR
IN ONTARIO, 1987 AND 1989

County	Municipality	Bluebox	1987					1989					
			Newsprint	Glass	Tin	PET	Total	Newsprint	Glass	Tin	Aluminum	PET	Total
			(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)
Metro	Toronto	128300	5110	613	102		5825	11162	2245	1219	115	36	14778
	Etobicoke	64000	3498	105			3603	5568	1120	608	58	18	7372
	Scarborough	111000	4378	10	83		4471	9657	1943	1055	100	31	12785
	North York	92000	2935	34			2969	8004	1610	874	83	26	10597
	York	30000		8	3		11	2610	525	285	27	8	3455
	East York	22000	586				586	1914	385	209	20	6	2534
Durham	Oshawa	34000	1953	23	8		1984	2958	595	323	31	10	3916
	Ajax	14300	1348	237	79		1664	1244	250	136	13	4	1647
	Newcastle	7000	586	24	11		621	609	123	67	6	2	806
	Pickering	15000	736	53	5		794	1305	263	143	14	4	1728
	Whitby	12500	603	24	13		640	1088	219	119	11	4	1440
	Brock	3000					0	261	53	29	3	1	346
	Scugog	2500					0	218	44	24	2	1	288
	Uxbridge	1700					0	148	30	16	2	0	196
Halton	Burlington	29700	4267	359	97	2	4725	2584	520	282	27	8	3421
	Halton Hills	6800	420	106	20		546	592	119	65	6	2	783
	Milton	6100	723	149	66		938	531	107	58	5	2	703
	Oakville	27500	3089	386	70		3545	2393	481	261	25	8	3167
Hamilton/ Wentworth	Hamilton	81000	3996	517	228		4741	7047	1418	770	73	23	9330
	Stoney Creek	11600	962	123	56		1141	1009	203	110	10	3	1336
	Ancaster	5160	481	58	29		568	449	90	49	5	1	594
	Dundas	6000	503	65	28		596	522	105	57	5	2	691
	Flamborough	3000					0	261	53	29	3	1	346
	Glanbrook	3100					0	270	54	29	3	1	357
Niagara	Niagara Falls	23800	1786	353	187		2326	2071	417	226	21	7	2741
	Port Colborne	7000	29	5	4		38	609	123	67	6	2	806
	St Catharines	39000	776				776	3393	683	371	35	11	4492
	Welland	15700	58	11	6		75	1366	275	149	14	4	1808
	Thorold	7000	53	11	6		70	609	123	67	6	2	806
	Fort Erie	11600					0	1009	203	110	10	3	1336
	Grimsby	5400	515	105	55		675	470	95	51	5	2	622
	Lincoln	3000	284	59	37		380	261	53	29	3	1	346
	Niagara on the Lake	5200					0	452	91	49	5	1	599
	Pelham	3500	327	67	35		429	305	61	33	3	1	403
	Wainfleet	3000					0	261	53	29	3	1	346
Ottawa	West Lincoln	1900	164	33	18		215	165	33	18	2	1	219
	Ottawa	78100	6165	2004	711		8880	6795	1367	742	70	22	8996
	Kanata	10000	708	140			848	870	175	95	9	3	1152
	Nepean	26300					0	2288	460	250	24	7	3029
	Gloucester	24300					0	2114	425	231	22	7	2799
	Cumberland	12000					0	1044	210	114	11	3	1382
	Osgoode	4200					0	365	74	40	4	1	484

Table 3.14 (Cont'd)
MATERIALS RECOVERED IN THE RESIDENTIAL SECTOR
IN ONTARIO, 1987 AND 1989

County	Municipality	Blucbox	1987					1989					
			Newsprint	Glass	Tin	PET	Total	Newsprint	Glass	Tin	Aluminum	PET	Total
			(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)
Peel	Brampton	45600	2721	269	135		3125	3967	798	433	41	13	5252
	Mississauga	98000	9825	1944	711		12480	8526	1715	931	88	27	11288
	Caledon	10300	20				20	896	180	98	9	3	1186
Waterloo	Cambridge	24500	1136	305	150		1591	2132	429	233	22	7	2822
	Kitchener	35300	3821	817	391		5029	3071	618	335	32	10	4066
	Waterloo	15300					0	1331	268	145	14	4	1762
	Wilmot	4300					0	374	75	41	4	1	495
York	Markham	40000	469	120	12		601	3480	700	380	36	11	4607
	Newmarket	15000					0	1305	263	143	14	4	1728
	Richmond Hill	19000	963	97	16		1076	1653	333	181	17	5	2188
	Vaughan	26000	27	8			35	2262	455	247	23	7	2995
	Whitchurch-Stouffvil.	5300	129	28	5		162	461	93	50	5	1	610
	East Gwillimbury	5700					0	496	100	54	5	2	657
	Georgina	12500					0	1088	219	119	11	4	1440
	King	6400					0	557	112	61	6	2	737
Muskoka	Bracebridge	5400	294	70	33		397	470	95	51	5	2	622
	Gravenhurst	4400					0	383	77	42	4	1	507
	Huntsville	6700					0	583	117	64	6	2	772
	Georgian Bay	2340					0	204	41	22	2	1	270
	Muskoka Lakes	6500	11	9			20	566	114	62	6	2	749
Brant	Brantford	25000					0	2175	438	238	23	7	2880
	Paris	2700					0	235	47	26	2	1	311
	South Dumfries	1450					0	126	25	14	1	0	167
Bruce	Bruce Twp	1200					0	104	21	11	1	0	138
	Mildmay	450					0	39	8	4	0	0	52
	Elderslie Twp	1700					0	148	30	16	2	0	196
Dufferin	Orangeville	5000					0	435	88	48	5	1	576
	Shelburne	1200					0	104	21	11	1	0	138
	Mono	2200					0	191	39	21	2	1	253
Essex	Windsor	85700	1741				1741	7456	1500	814	77	24	9871
	Ambertsborg	2800	149	51	29		229	244	49	27	3	1	323
	Essex	2000					0	174	35	19	2	1	230
	Learnington	4700					0	409	82	45	4	1	541
	Tecumseh	3000					0	261	53	29	3	1	346
	Sandwich West	4400					0	383	77	42	4	1	507
Frontenac	Kingston	13000					0	1131	228	124	12	4	1497
	Kingston Twp	10500					0	914	184	100	9	3	1209
	Pittsburg	2200					0	191	39	21	2	1	253
Grey	Owen Sound	6200	90				90	539	109	59	6	2	714
	Durham	1200					0	104	21	11	1	0	138
	Hanover	2300					0	200	40	22	2	1	265
	Newstadt	200					0	17	4	2	0	0	23
	Egremont Twp	5600					0	487	98	53	5	2	645

Table 3.14 (Cont'd)
MATERIALS RECOVERED IN THE RESIDENTIAL SECTOR
IN ONTARIO, 1987 AND 1989

County	Municipality	Bluebox	1987					1989					
			Newsprint	Glass	Tin	PET	Total	Newsprint	Glass	Tin	Aluminum	PET	Total
			(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)
Huron	Howick	700					0	61	12	7	1	0	81
	Wingham	1100					0	96	19	10	1	0	127
	Grey Twp	100					0	9	2	1	0	0	12
Kent	Ridgetown		22				22						0
Lambton	Sarnia			21			21	0	0	0	0	0	0
	Forest	11100					0	966	194	105	10	3	1278
Leeds & Grenville	Brockville	6400					0	557	112	61	6	2	737
Lennox & Addington	Ernestown	3700					0	322	65	35	3	1	426
Middlesex	London		3315				3315	0	0	0	0	0	0
	London Twp	1400					0	122	25	13	1	0	161
	Lobo	1200					0	104	21	11	1	0	138
	West Nissouri	1000					0	87	18	10	1	0	115
	North Dorchester	2500					0	218	44	24	2	1	288
Northumberland	Campbellford	1500					0	131	26	14	1	0	173
	Cobourg	3000	306	50			356	261	53	29	3	1	346
	Port Hope	2700	224	27	8		259	235	47	26	2	1	311
	Brighton	1500					0	131	26	14	1	0	173
	Colbourne	800					0	70	14	8	1	0	92
	Haldimand	400	33	7			40	35	7	4	0	0	46
	Hamilton	1700	19	5			24	148	30	16	2	0	196
	Hope	500	34	7			41	44	9	5	0	0	58
Oxford	Woodstock		502	141	37		680						0
	Ingersoll	2900					0	252	51	28	3	1	334
	E. Zorra-Tavistock	2200					0	191	39	21	2	1	253
	S W Oxford	2750	144	78	54		276	239	48	26	2	1	317
	Zorra	2900					0	252	51	28	3	1	334
Perth	Stratford	7500	575	222	122		919	653	131	71	7	2	864
	St Mary's	1800					0	157	32	17	2	1	207
	Mitchell	1200					0	104	21	11	1	0	138
	Milverton	500					0	44	9	5	0	0	58
	North Easthope	750					0	65	13	7	1	0	86
	South Easthope	750					0	65	13	7	1	0	86
	Downie	800					0	70	14	8	1	0	92
	Hibbert	150					0	13	3	1	0	0	17
Peterborough	Peterborough	21500	1671	326	129		2126	1871	376	204	19	6	2476
Renfrew	McNab	1300					0	113	23	12	1	0	150
Simcoe	Barrie	15000	988	120	50		1158	1305	263	143	14	4	1728
	Alliston	15050					0	1309	263	143	14	4	1733
	Collingwood	4000					0	348	70	38	4	1	461
	Midland	5000	98	38	22		158	435	88	48	5	1	576

Table 3.14 (Cont'd)
MATERIALS RECOVERED IN THE RESIDENTIAL SECTOR
IN ONTARIO, 1987 AND 1989

County	Municipality	Bluebox	1987					1989					
			Newsprint	Glass	Tin	PET	Total	Newsprint	Glass	Tin	Aluminum	PET	Total
			(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)	(t/yr)
Simcoe	Penetanguishene	2200	169	67	40		276	191	39	21	2	1	253
	Stayner	1200					0	104	21	11	1	0	138
	Wasaga	5500					0	479	96	52	5	2	633
	Adjala		31	13			44						
	Creemore	500					0	44	9	5	0	0	58
	Tottenham			32	13		45						
	Innisfil	8200					0	713	144	78	7	2	944
	Orillia	8700					0	757	152	83	8	2	1002
	Essa	3500					0	305	61	33	3	1	403
	Nottawasaga Twp	500					0	44	9	5	0	0	58
	Oro	4000					0	348	70	38	4	1	461
	Tay	3500	22	8	4		34	305	61	33	3	1	403
	Tiny	7400	22	9	5		36	644	130	70	7	2	852
	Elmvale	700					0	61	12	7	1	0	81
	Victoria Harbour	600					0	52	11	6	1	0	69
	Port McNicholl	800	13	5	2		20	70	14	8	1	0	92
Stormont-Douglass	Winchester	700					0	61	12	7	1	0	81
							0						
Victoria	Lindsay	5150					0	448	90	49	5	1	593
	Fenelon Falls		18				18	0	0	0	0	0	0
Wellington	Guelph	22800	1499	408	128	34	2069	1984	399	217	21	6	2626
	Fergus	2450	150	43	18		211	213	43	23	2	1	282
	Mount Forest		3623				3623						
	Elora	1000					0	87	18	10	1	0	115
	Erin	800					0	70	14	8	1	0	92
	Eramosa	800					0	70	14	8	1	0	92
	Erin Twp	600					0	52	11	6	1	0	69
	Maryborough	6200					0	539	109	59	6	2	714
	Nichol	500					0	44	9	5	0	0	58
	Peel Twp	150					0	13	3	1	0	0	17
	Puslinch	1400					0	122	25	13	1	0	161
	West Garafraxa	300					0	26	5	3	0	0	35
Kenora	Dryden	3000					0	261	53	29	3	1	346
	Subtotal	1792000	81913	11027	4071	36	97047	155904	31360	17024	1613	502	206403
	Provincial Total 1987	97047											
	Provincial Total 1989	206403											

Table 3.15
QUANTITIES OF RECYCLED MATERIALS REPORTED
BY THE ONTARIO MUNICIPAL RECYCLING SUPPORT PROGRAM

Material	1989 Total (Tonne)
Newspaper	65242.36
Glass	18981.56
Steel	8765.13
Aluminum	1001.78
PET	571.96
Provincial Total	94562.79
Source: MOE, 1990 Municipal Recycling Support Program (handout).	

Table 3.16
SUMMARY OF RESIDENTIAL SOLID WASTE GENERATION
AND RECYCLING DATA FOR ONTARIO 1987 AND 1989

	1987	1989
Residential solid waste quantity generated in Ontario (tonnes)	3,901,900	4,053,200
Residential waste recycled in Ontario (tonnes)	97,000	206,400
Percentage of residential waste recycled in Ontario	2.5%	5.1%
Quantity of residential waste disposed in landfills or incinerators (tonnes)	3,804,900	3,846,800
• Estimates rounded off		

- The Region of Peel, which has assumed a leadership position in the banning of ICI waste materials, advocates the need to provide alternative recovery sources for the materials. Applying this stewardship attitude, the Region has endorsed, and in some cases financially assisted, enterprising recycling and end-user companies.
- The City of Toronto offers diversion credits to commercial establishments for the recovery of corrugated cardboard from retail stores and glass containers from restaurants and taverns. These recycled materials are picked-up by the City and processed at appropriate recycling companies.

Table 3.17
MATERIALS BANNED FROM LANDFILLS AND MUNICIPAL COLLECTION
IN THE GREATER TORONTO AREA

County	Municipality	Tires	OCC	Dry Wall	Lumber	Leaves	White Goods	Fine paper	Constr/Demo	Other
Durham	Region	Y	Y	P	N	Y	Y	N	N	Blue Box
Halton	Region	>5Y	Y	Y	N	N	Y	N	N	
Metro	Metro	Y	Y	P	N	Y	Y	N	N	
Peel	Region	Y	Y	Y	Y	N	N	N	N	
	Brampton	Y	Y	Y	Y	N	N	N	N	
	Mississauga	Y	Y	Y	Y	N	N	N	N	
	Caledon	Y	Y	Y	Y	N	N	N	N	
York	Georgina	N	N	Y	N		N	N	Y	stumps, logs
	Markham	Y	Y	Y	N	Y	Y	N	Y	
	Newmarket	N	N	N	N	Y	Y	N	N	
	Vaughan	N	N	Y	N	Y	N	N	N	
	Whit-Stouffville	N	N	Y	N	Y	Y	N	N	

Y = yes N = no

P = potential

Reference: MacViro Consultants Inc. 3Rs Action Plan for SWISC, Toronto, Ontario April 1990.

Note: Generally regional governments are responsible for garbage disposal, hence regional policy affects local garbage collection.

In other cases, municipalities are taking a more proactive role in promoting waste reduction activities. In 1989, Toronto's City Council passed a bill requiring all new major developments to provide for waste reduction and recycling activities. Detailed waste reduction and recycling plans, to be submitted for approval by the Commissioner of Public Works, require a description of the expected waste stream composition as well as a description of the proposed waste reduction/recycling program. Provisions must be made for adequate storage and handling space for wastes being recycled, with attention paid to appropriate equipment and structural design needs.

Government grant programs also promote waste reduction and recycling programs in industry. In June 1987, the Ministry of the Environment announced its comprehensive funding program for waste management. The Industrial Waste Diversion Program provides industries with financial assistance in developing 4R strategies (reduce, reuse, recycle and recover). Industries are eligible for up to 50% of the capital and start-up costs and up to 100% of the research and demonstration costs for 4R projects.

The program's progress to date was summarized as follows: (Closing the Loop, the 3Rs of Waste Management, MOE, 1990).

"...more than 180 industrial 3Rs projects have been funded up to June 1990 with a potential to divert from disposal 73,000 tonnes of hazardous materials, 15.5 million litres of liquid wastes and 661,000 tonnes of industrial/commercial solid wastes".

The recycling market has begun to take advantage of funding programs and the opportunities available to capture ICI solid waste materials that are banned from landfills. In Ontario, a number of innovative businesses have begun to address the solid wastes produced by the ICI sector:

Drywall

- New Westminster Gypsum Company - Drywall is recycled using a process that separates the paper material from the gypsum materials then pulverizes the gypsum to be later used as a substitute for virgin material in the construction of new drywall. The company estimates that it can accommodate 85% of the construction industry's discarded clean drywall.

Polystyrene

- Canadian Polystyrene Recycling Association - CPRA has embarked on a program to recycle polystyrene generated by the ICI sector and fast food chains. The group is currently in the process of building a recycling facility. Polystyrene will be palletized and used in the manufacturing of

low grade plastic products, such as blue boxes, snow fences, and drainage pipes.

Textiles

- H&I Carpets - In association with other carpet manufacturers, this company is aggressively attacking the issue of carpet recycling. Efforts are underway to develop a method to effectively separate the backing from the fibre part of the carpet. H&I Carpets are working closely with ORTECH to resolve the separation problem.

Tires

- Viceroy-Trent Group - A technology has been developed to reduce tire rubber into crumb rubber to be used as a material input in the manufacturing of shoe soles, rubber hoses, garbage cans, composters, blue boxes, door mats, car mats, etc. The company will use this technology in its tire recycling facility, which will have a capacity of 9 million tires recycled/year at the end of five years.

Wood Waste

- WCI Waste Conversion Inc. - Launched in November 1989, this company has initiated a wood waste pilot project to research and develop new end uses for a number of wood wastes that cannot be currently recycled such as plywood, particle board and other building materials, railway ties, compost, and fire logs.

3.5.2 Data Availability and Limitations

Despite the recent endeavour to divert ICI wastes from landfills, relatively little recording activity has taken place. As occurred in the early stages of the Blue Box program, recycling program coordinators have focused their energies on the implementation of recycling programs, leaving data collection and recording for later.

Two sources have produced preliminary figures relating to ICI recycling programs.

- Solid Waste Interim Steering Committee, 3Rs Action Plan

Part of the Greater Toronto Area (GTA) management system, the SWISC committee published a report outlining current 3R initiatives in the five regions comprising the GTA (Metropolitan Toronto, Peel, Halton, Durham and York). Recycling figures for the ICI sectors are reported, where available, in the document.

- **Resource Integration Systems, Market Assessment of 3R's Activities**

RIS, in conjunction with VHB, has prepared a report on the recycling market's development in 1989 and the potential for future development. The report identifies key materials targeted for diversion in municipal recycling programs. Markets were assessed by the quantity of materials recycled in 1989 and their ability to absorb more materials in the future.

The RIS report has produced estimates of ICI recycling rates using a variety of sources and methodologies. For some materials, RIS acknowledges that information is not available. The available numbers are summarized in Table 3.18.

In addition, the SWISC report provides useful but limited data on the diversion of ICI waste materials through recycling programs. These figures are provided in Table 3.19.

At present, the ICI sector appears to be having difficulty quantifying the amount of solid waste materials generated on site. Until industries, commercial businesses and institutions can determine the types and amounts of solid waste being generated, there is little hope for companies to formulate comprehensive waste diversion data. However, as the current rate of recycling activity in the ICI sector increases, more emphasis will be placed on collecting and recording the quantities of materials recycled.

Table 3.18
ESTIMATED QUANTITIES OF MATERIAL RECYCLED BY
THE ICI SECTOR IN 1989 (TONNES)

Component	Estimated Quantity Recycled in 1989
Old Newsprint (ONP)	0
Fine Paper	30,000
Mixed Paper	0
Boxboard	0
Corrugated Cardboard	110,300
Magazines	0
Telephone Directories	0
Plastics	0
Container Glass	5,800
Tinplate Steel Cans	60
Aluminum	100
Food Waste	30,000
Disposal Diapers	400
Wood Waste	96,000
Drywall	1,000
Scrap Tires	6,000
Total	279,760

Source: RIS Market Assessment of 3R's Activities in Ontario 1991 Table 19.1

Table 3.19
ESTIMATED QUANTITIES OF ICI WASTE RECYCLED IN THE GREATER
TORONTO AREA

Component	Quantity Reported
OCC	93,000
Fine Paper	6,800
Plate Glass	2
Container Glass	15
Tires	2,300
Oils	0
Solvents	0
Drums	0
Metal	5
Plastic	350
Rubber	0
Textiles	30
Other 1	2,550
Other 2	18,000
Total	123,052
Source: SWISC, 1990	

Section 4

PHYSICAL AND ECONOMIC DIMENSIONS OF THE WASTE MANAGEMENT SYSTEM

4.1 GENERAL DESCRIPTION OF THE SYSTEM

One of the objectives of the study was to follow the waste stream from the point of generation to the point of disposal or end-use. Where possible, this study identifies the waste handling and management methods used by the counties and municipalities in Ontario and provides a review of the relevant players involved in the waste management activities. However, adequate data are not available to directly link specific generators of waste with specific receivers of waste.

Figure 4.1 has been developed to introduce the reader to the configuration of the waste management system in Ontario, as well as to the terminology used throughout this text. Some minor material flow paths have been excluded from the figure. Where available, estimated quantities have been added to flow paths.

This Section has been developed to describe haulage and disposal pathways, while Section 5 addresses recycling of waste materials. Information on the following components of the waste management system is discussed in this Section:

- landfills
- incinerators
- transfer stations
- haulers

4.2 LANDFILLS

4.2.1 General Description

Landfilling is the most common method of waste management used in Ontario. A landfill is typically developed or filled in cells. Each cell is excavated, filled with garbage, which is compacted and covered with clean material. Garbage is disposed in one small area of a landfill at any given time. This is referred to as the "working face". The area being filled is covered at the end of the day to prevent the nuisance of windblown garbage to surrounding areas. When completed, the landfill surface is shaped to finished contours. Modern landfill design is carried out under design and operation standards which mitigate environmental hazards. This involves consideration of a number of factors, as discussed below and illustrated in Figure 4.2.

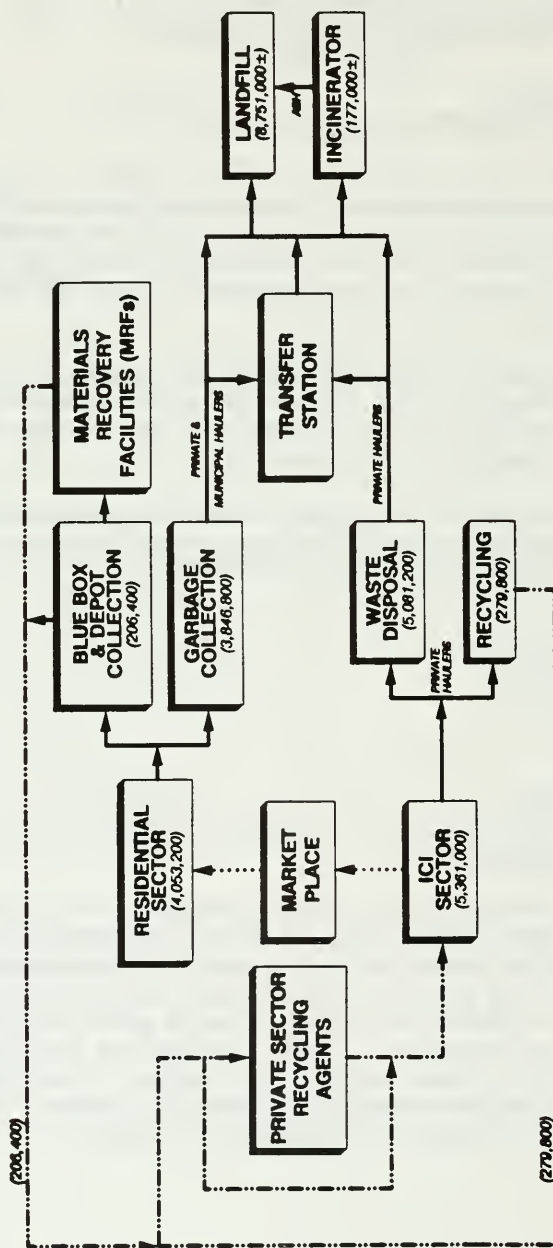


Figure 4.1
ONTARIO'S WASTE MANAGEMENT SYSTEM
AND IDENTIFIED MATERIAL
FLOW QUANTITIES, 1989

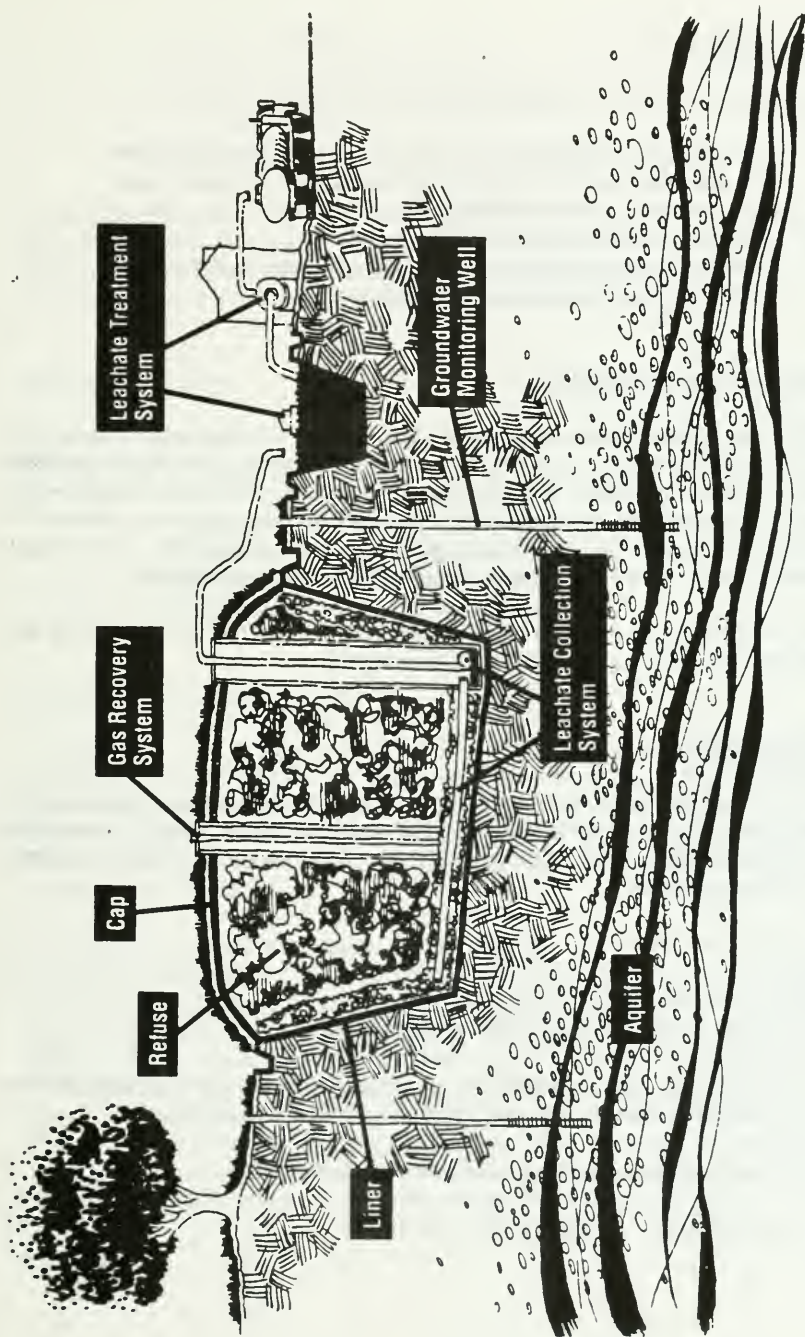


Figure 4.2
MODERN LANDFILL DESIGN
Reference: NSWMA, 1990

Leachate Management

The main elements of leachate management are:

- Use of low permeability cap to prevent or minimize infiltration.
- Site selection based on high natural attenuation of native soils.
- Placement of a clay or synthetic liner.
- Leachate collection, removal and treatment.
- Adequate surface drainage and flooding properties at the site.
- Prohibition on disposing liquid wastes.

Refuse Generated Gas Management

As solid waste decomposes, gases, consisting largely of carbon dioxide and methane, are generated. Control of this gas is necessary to eliminate odours and prevent off-site migration of methane in the soil. Piping is placed alternately with layers of solid waste to vent the gases and prevent the buildup of differential gas pressures in the system. In some cases, gas removal is enhanced using a pumping system and, in the case of larger sites, recovery of methane as a heating or combustion fuel may be feasible.

For landfills where the above system was not incorporated into the initial design, a top down retroactive gas vent installation can be considered.

Nuisance Management

Proper compaction of waste using heavy equipment such as compactors and dozers and use of cover material on a daily basis will reduce nuisance aspects such as dust, litter and pests. Operating hours agreeable to neighbours and well-planned haul routes will minimize traffic complaints.

Site Records

Site records should be kept of the following information:

- Source quantity and type of waste received from each incoming vehicle, as well as identification and time of arrival of each vehicle.
- Each vehicle rejected and/or waste loads removed.
- Daily tally of tonnage or waste received.

- Quantities of clean fill imported.
- Ultimate use made of imported fill.
- Data accumulated from the site monitoring programs.

Landfill development should be documented annually and contour mapping produced. Inspection records should be kept on the installation of all site works, and on any remedial work carried out. Notes should be kept on construction problems and on complaints from area residents including the responses given.

Monitoring Strategy

Monitoring will ensure continued satisfactory performance of the landfill. This should include aspects such as:

- Protection of the integrity of the containment system.
- Maintenance of the gas control system.
- Maintenance of the leachate collection, removal and treatment system.
- Groundwater monitoring at near-site wells.

Closure and Post-Closure Care

A protective cover or cap is necessary to ensure that liquid infiltration to the site is minimized over the long term. This cover should be of low permeability and be vegetated. Such a system could consist of a native soil cover, a high permeability drainage layer to intercept infiltration through the cover and a low permeability cap, placed directly over the waste, constructed of native clays, synthetic membranes or a soil/bentonite mixture.

Finally, the potential for long-term, unacceptable environmental impacts has led to increasingly stringent conditions of approval being imposed on new landfill sites. Financial commitments are required to ensure the continuation of leachate and gas monitoring beyond site closure until such time as it is shown to be unnecessary. Therefore, provisions for long-term contaminant control, with suitable contingency measures, must be included in financial planning for land disposal sites. Long-term funding requirements could include environmental impairment insurance, small claims funding and funds to adequately maintain the closed site. Also, it should be borne in mind that whether privately or municipally owned, the major site users (e.g. municipalities served) may still be responsible for future works required at the site.

4.2.2 Physical Dimensions

As discussed in Chapter 2, the primary source of information on landfills was the Site Summary Reports (SSR) provided through the Waste Management Branch. These provided the following information:

- Location
- Certificate of Approval holder
- Operator
- Municipalities served
- Tonnages of domestic, commercial and non-hazardous industrial wastes received.
- Start-up date for landfill
- Remaining life of the site

The latter information was based on the date of the SSR for each site. These dates ranged from 1983 to 1988 and so the remaining life figures do not provide a consistent basis for estimating the closure date of the landfill.

Information from WMMPs was used to update the SSR data where it was possible to confirm a match of records on a specific landfill. In general, little new information was gleaned from this exercise, with the exception of tonnage data.

These two sources of information contained no information on landfills in northern Ontario. Well over half of the landfills in Ontario are located in the Northwestern and Northeastern Regions. The MOE Approvals Branch provided a listing of major landfills in the Northeastern Region and the Northwestern Regional MOE office supplied information for its area. For the Northwestern Region, landfills serving more than 1,000 people were identified, while in the Northeastern Region, landfills serving more than 1,500 people were listed. In total, this amounted to fewer than 100 landfills. Unfortunately only location information was available on these landfills.

The mail-out survey conducted by VHB and MacLaren as part of a concurrent study received responses from more than 200 landfills in Ontario. The database file on landfills was updated to include data from the VHB/MacLaren survey on:

- remaining life
- capital and operating costs
- full- and part-time employment
- 1989 tipping fee

The data on remaining life obtained from the VHB/MacLaren survey is considered more accurate than that from the SSRs.

The preceding exercise compiled the most comprehensive record of landfills possible for this study. However, it is important to recognize the limitations of the information gathered. Many medium and small landfills have no facilities to weigh incoming waste and therefore tonnages may be estimates only, or missing entirely in many cases. All of the SSR and VHB/MacLaren survey information is based on self-report, resulting in little quality control on the data. Nonetheless, this is believed to be the most up-to-date and comprehensive information available.

Inventory figures from the Waste Management Branch indicate that approximately 630 (45%) of Ontario's landfill sites serve communities with populations less than 1,500; these communities constitute approximately 10% of Ontario's total population. Another 350 (25%) of Ontario's landfills are operated by the Ministry of Natural Resources. These landfills are operated to serve provincial parks and other recreational facilities on crown land, areas of seasonal residences (i.e. cottages) and other MNR activities such as clearing associated with reforestation. The main focus of this study has been on the remaining 30% (roughly 420) of the landfill sites serving populations greater than 1,500. The database created as part of this study includes information on the MNR sites.

Landfill Closure Trends

Since the publication of "Blueprint for Waste Management in Ontario" by the MOE in 1983, increasing attention has been paid to waste management issues. One of the most important of these is the ongoing closure of landfills as capacities are reached, while approvals for new landfills have ground to a virtual halt due to public concerns over environmental acceptability.

As an example of the critical nature of this issue, approximately 18% of Ontario's annual landfill capacity will be lost in 1991, with the closure of two of the province's three largest landfills. Together, Britannia (750,000 tonnes/year), Brock West (964,000 tonnes/year) and Keele Valley (2,250,000 tonnes/year), all located in the Greater Metro Toronto area, accept approximately 42% of the total provincial annual waste generation. Two of these landfills, Britannia Road in Mississauga, and Brock West in Pickering, are projected to close at the end of 1991. Britannia Road may remain open longer if the existing site is filled beyond originally approved final contours. This issue is under consideration at this time and a final decision has not been reached. If both landfills close as projected, an estimated 18% of the Provinces landfill capacity will be lost. The Keele Valley site is projected to close in 1993-1994, eliminating a further 24% of the Provinces landfill capacity.

The Site Summary Reports provide estimates of landfill life expectancy in years. This information was entered into the study database directly. Information received from the MOE indicates that these data were calculated based on the year of the Site Summary update. Using this information, the number of landfills expected to reach their

approved capacities at various times was calculated. Since the Site Summary Reports were updated between 1983 and 1988, it has not been possible to verify whether closures anticipated for the period 1983 to 1990 occurred. Although considered of limited value, the results of this exercise are discussed below and are presented in more detail in Section 4.2.5.

Out of 665 landfill records obtained for this study approximately 34% (224) have no data regarding the remaining life expectancy of the landfill. Of the 499 records that have this information, 158 (32%) indicate a remaining landfill life of seven years or less. Because the base year of the data was generally 1983, the SSR suggests that these 158 landfills can be assumed to have reached their approved capacity by 1990. The SSR data further suggest that an additional 95 (19%) landfills will reach capacity in the 1991-1993 period. An additional 145 (29%) will attain full capacity between 1994 and 2003 with only 101 (20%) extending beyond 2004.

Eighty-one of the landfills expected to reach their approved capacity by 1990 receive less than 5,000 tonnes of wastes per year. Only 6% of the landfills expected to reach capacity by 1990 received wastes in excess of 50,000 tonnes annually. For landfills expected to attain full capacity in the 1991-1993 period, 84% receive wastes at rates less than 5,000 tonnes per year. However, two of the three largest landfills in Ontario are also expected to reach capacity during this period.

Landfills expected to reach capacity in the period between 1983 to 1990 are distributed fairly evenly across the province with one to five landfill closures per county. Based on the available information, a large proportion of the landfills expected to reach capacity are located in Peterborough County, Simcoe County, Haliburton County and Niagara Region. Landfills expected to reach capacity during the 1991-1993 period are also evenly distributed among the counties. During the period from 1994-2003 there will be one to five landfills reaching approved capacity for each county with the exception of Renfrew, Bruce, Frontenac, Huron, and Peterborough Counties, where more than five closures are expected.

The above data need to be verified by an update of all SSR's, preferably carried out in the same base year. The focus on waste management has changed dramatically since some of the SSR work was initially carried out. It is likely that more comprehensive data would be available on projected closure dates etc. if all SSR's were updated in 1991. Landfill closures are discussed further in Section 4.2.4. Future Trends.

4.2.3 Economic Dimensions

Landfill Tipping Fees

Tipping fee information was obtained from Waste Management Master Plan data as well as the mail survey conducted by VHB/MacLaren, as part of a concurrent study.

Responses were received for 205 landfills, 56 large landfills receiving more than 5,000 tonnes of waste per year and 149 small landfills receiving less than 5,000 tonnes of waste per year. In addition, some tipping fees were obtained from WMMPs.

Tipping fees at small landfill sites, (less than 5,000 tonnes of waste per year), vary from zero to fees based on vehicle size. Only 37 (25%) of the small landfill respondents indicated that they had a tipping fee. Only 12 (8%) indicated that a specific portion of the waste management costs were accounted for by the tipping fee. Most of the smaller landfills do not have weigh scales and, therefore, cannot charge a fee based on tonnage. Generally, the revenues earned from tipping fees are used to pay the salaries of the employees who control access to the site.

Of the 56 large landfill (greater than 5,000 tonnes of waste per year) survey respondents, 13 (23.2%) indicated that they had no tipping fees. Seventeen (30.4%) landfills charge tipping fees based on vehicle size and/or type of waste material (e.g. charge per tire). Four of the landfills surveyed charged more than \$90 per tonne at the time of the survey (summer 1990) including Brock West, Keele Valley and Britannia. Three landfills charged between \$70 and \$90 per tonne, eight between \$30 to \$70 and five less than \$30. Seven respondents did not provide information on tipping fees. Only 19 (38%) of the respondents indicated that a specific part of their waste management costs are accounted for in the tipping fee. The preceding discussion pertains to 1990 tipping fees, while 1989 tipping fees appear in the landfill database.

There are a variety of ways to charge a tipping fee on a vehicle entry basis. The simplest method is to charge a per vehicle rate for each entry into the landfill. The rates can be based on vehicle type or weight capacity. Vehicle type categories can range from personal use cars, cars with trailers, commercial truck (1/4-1 ton), cube vans and platform bodies, lugger containers and rollofs to compactors, refuse trucks and semi-trailers. Often a higher tipping fee (in some cases twice as high) is charged to non-residents of the area served by the landfill. Table 4.1 summarizes reported vehicle based tipping fees from 1987 to 1990.

Table 4.2 lists available information on tonnage based tipping fees since 1984 for a number of municipalities. Information on selected municipalities appears in graphical form in Figure 4.3. It is important to note the dramatic rise in tipping fees, especially since 1987 and in larger centres. It is interesting that in smaller centres such as Lindsay there has been some resistance to raising tipping fees. Fears that illegal dumping may result may soon be offset if other municipalities begin to take advantage of lower tipping fees. For example, the costs to haul waste to Lindsay from Peterborough may justify taking advantage of the difference in tipping fees noted in Figure 4.3.

It is also noteworthy that tipping fees in the Greater Toronto Area have increased to \$150/tonne in 1991.

Table 4.1
SUMMARY OF AVAILABLE DATA ON VEHICLE BASED TIPPING FEES
IN ONTARIO (1987-1989)

Site Location	1987	1988	1989	1990
Cobourg		\$0-20/VEH.	\$3-45/VEH.	5.75/C.Y.
Hanover/Walkerton	\$1-10/VEH. RES \$2-14/VEH. NRES			
Brockville		\$0-64/VEH. RES \$5-128/VEH. NRES	\$0-130/VEH. CRES \$10-260/VEH. CNRES	\$0-130/VEH. CRES \$45-345/VEH COMM
Thurlow Twp			\$10-125/VEH. NC \$75-125/VEH. C	\$10-125/VEH. NC \$75-125/VEH. C
Listowel	0	0	0	0
Mosa	0	0	0	\$25/TRAILER SHINOLES ONLY
Kincardine	0	0	0	0
Baxter	0	0	0	0
Fonthill	0	0	0	0
Fort Erie	0	0	0	0
Niagara on the Lake	\$0-125/VEH.	\$0-125/VEH.	\$2-160/VEH	\$2-216/VEH.
West Garafraxa	0	0	0	0
Keswick	0	0	0	\$10-100/VEH
Morrisburg	0	0	0	0
Wasaga Beach	0	0	0	0
Niagara Falls	0	0	0	0
Ameliasburgh	0 0	0 0	0 0	\$5 PER 1/2 TON TRUCK \$100/ SINGLE AXEL
Welland	0	0	0	0
Tillsonburg	0	0	0	0
St Catharines	0	0	0	0
King Twp	0	0	0	0
Mitchell	0	0	0	\$5-10/VEH
Durham	0 0	0 0	0 0	\$6-80/VEH. R \$8-100/VEH NR
South Hampton	0	0	0	\$2-70/VEH.
Wingham	0	0	0	0
Pembroke	0	0	0	0
Chesley	\$25/LOAD/ENTRY ON UNOPENED DAYS	\$25/LOAD/ENTRY ON UNOPENED DAYS	\$25/LOAD/ENTRY ON UNOPENED DAYS	\$25/LOAD/ENTRY ON UNOPENED DAYS
Renfrew	\$1.50-18/VEH	\$1.50-18/VEH	\$1.50-18/VEH	\$1.50-18/VEH
Moore Twp	\$0-3/C.Y. R \$3-5/C.Y. NR	\$0-3/C.Y. R \$3-5/C.Y. NR	\$5-8/C.Y. R \$7-12/C.Y. NR	\$8/C.Y. R \$16/C.Y. NR
Hastings	0	0	0	\$10-150/VEH
Almonte	\$2-100/VEH	\$2-100/VEH.	\$2-100/VEH.	\$2-150/VEH.
Pualinch	\$14/TONNE COMM.	\$14/TONNE COMM.	\$30/TONNE COMM	\$76/TONNE

Source: Data obtained from landfill survey completed by VHB Research & Consulting, Inc.

Table 4.2
SUMMARY OF DATA ON TONNAGE BASED LANDFILL
FEES IN ONTARIO 1984-1990

Location	Reported tipping Fee \$/tonne				
	1984	1987	1988	1989	1990
Barrie			12.50	28.30	85.00v
Belleville/Napanee			34		
Brantford			10	13	
Collingwood				15	50
Durham			50	83.34	
Essex-Windsor	14		23.90	32.50*	
Gosfield		20-27 + v			
Grimsby		32	50	58v	85v
Guelph	0	14.6 43 + v	28	33 48 + v	38 76 + v
Haldimand-Norfolk				25.00 + 0a	
Halton Region	18	36.15	53.50	83.50	115
Hamilton-Wentworth	20	27	28.60	80	110
Hastings			17	37.50	
Huntsville		0v		27.50v	55v
Kitchener/Waterloo	7.95	17.05	30.80	4.75b 2.25c	
Lindsay		6-7v		12-13	20v
London		13.50	15.40		35
Mississauga (Brittania)		49.50 + v		70.90 + v	90.95 + v
Newcastle		20	60	95	115-130
Niagara Waste Systems			26		
North Simcoe				112 35	
Occidental (New York)		8.65			
Orillia				36.50	
Oro		0v		0v	25v
Ottawa			27.50	35 33	
Paris	0	0	0	25	
Peel Region	13.50	34.50	49.50	70	90
Peterborough	0	0	0	50	75
Pickering (Brock West)		18.07 + v		83.33 + v	97.50 + v
Port Elgin				0	
Red Lake area				0	
South Gray				7 + 83.34	
South Simcoe			50	83.34	
Steeley Industries Ltd		20	28	48	

Table 4.2
SUMMARY OF DATA ON TONNAGE BASED LANDFILL
FEES IN ONTARIO 1984-1990

Location	Reported tipping Fee \$/tonne				
	1984	1987	1988	1989	1990
Stratford		0	0	0	10
Sudbury Region			0	0	
Thunder Bay	3	7		8	
Timmins			0		
Metro Toronto	15.50	18.07	50	83.34	98
(at transfer stations)				100	15
Vaughan (Keele Valley)		18.07+v		83.33+v	97.50+v
Average Tipping Fee	13.28	20.80	33.93	49.40	76.61
Percentage Increase		56.6%	63.1%	45.6%	55.1%

Legend:

* -under review a -at all others c -per cubic year - loose
 + -at one facility b -per cubic yard - packed v -from VHB survey

Sources:

- Association of Municipal Recycling Co-ordinators (AMRC) files
 - MacLarens in-house files
 - VHB/MacLaren Survey (1990) where noted

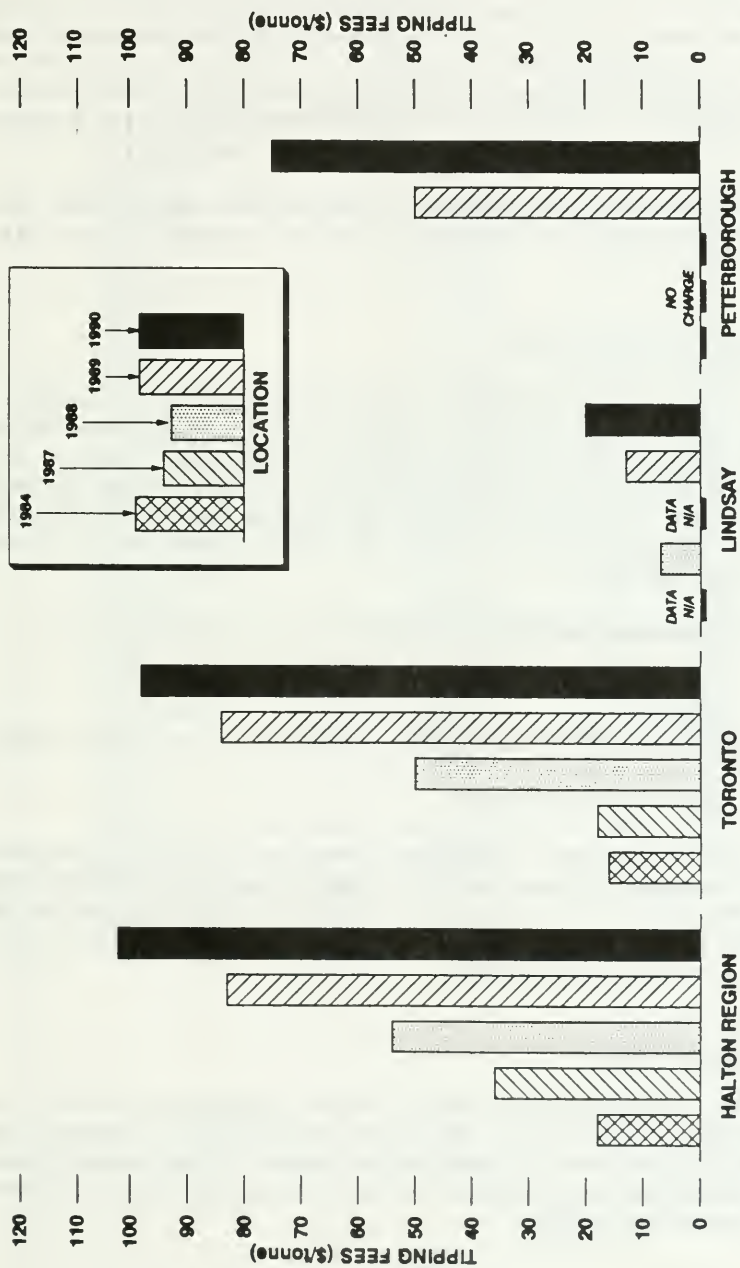


Figure 4.3
HISTORY OF LANDFILL TIPPING FEES
FOR SELECTED MUNICIPALITIES

Landfill Employment

Survey information on employment was only available for the large landfills. Forty-one (41) landfills responded indicating a total employment of 260 full time and 115 part time employees. Seventy six percent (76%) of the responding landfills employ five or less full time employees. Ninety-three (93) of the responding landfills employ five or less part time employees. Britannia, Brock West and Keele Valley collectively employ 60% and 26% of the reported full- and part-time employees respectively.

Table 4.3 and Figure 4.4 were developed from the data available and provide an overall picture of landfill staffing requirements as a function of the annual tonnage of waste received at a landfill.

Landfill Operating and Capital Costs

Capital and operating costs for landfilling can vary widely depending on a number of factors. Well-designed landfills address the question of leachate management by considering native soil types and treatment alternatives. Other factors which may contribute to variable landfill costs include average haulage distance, provision of closure and post-closure care funds and extent of programs to reduce impacts to neighbouring land uses. The latter may include use of cover material, litter fences and pest control (i.e. control of rats and gulls).

Other factors contributing to landfill costs include:

- Size of landfill
- Staff salary
- Equipment and maintenance (e.g. graders, compactors, dozers, scrapers, etc.)
- Engineering and approvals

Traditionally, municipalities have not maintained comprehensive records of costs associated with the operation of their landfills. Table 4.4 has been developed from MacLaren in-house files to show the range in costs for landfills of differing size and location. These costs should be considered generic, but representative of the types of landfills most commonly found in Ontario.

4.2.4 Future Trends

Landfilling is the most extensively used method of waste management in Ontario. Despite recent recycling efforts which, in 1989, diverted 206,400 tonnes of the waste produced by the residential sector in Ontario and an estimated 279,800 tonnes of waste produced by the ICI sector, up to 9,000,000 million tonnes of residential and commercial/industrial wastes were landfilled.

Table 4.3
COMPARISON OF LANDFILL UTILIZATION AND EMPLOYMENT FOR
SELECTED LANDFILLS IN ONTARIO

Site Location	Waste Received Tonnes/Year	Employees	
		Full Time	Part Time
Georgina Twp	12,200	2	0
King City	7,000	1	2
Huntsville	8,000	2	0
Georgian Bay	2,300	1	1
Barrie	43,360	4	2
Oro Twp	2,800	1	1
Cramahe	2,300	2	0
Haldimand	23,844	3	0
Percy	1,800	0	1
Ops	11,700	2	1
Albemarle Twp	1,300	0	0
Brant Twp	8,000	2	2
Saugeen Twp	2,400	0	1
Alice&Fraser Twp	28,080	2	3
Leeds&Lansdowne Twp	32,294	1	0
North Colchester	26,400	2	1
Maidstone	220,400	9	3
Tillsonburg	8,030	5	0
Listowel	3,700	0	1
Mitchell	2,000	1	0
Mississauga	748,338	30	1
Brock	964,004	45	10
Moore	12,000	0	2
Ottawa	n. a.	12	3
Guelph	6,657	0	3
Paris	9,844	4	0
Brantford	115,226	0	0

Source: VHB/MacLaren Survey Results (1990).

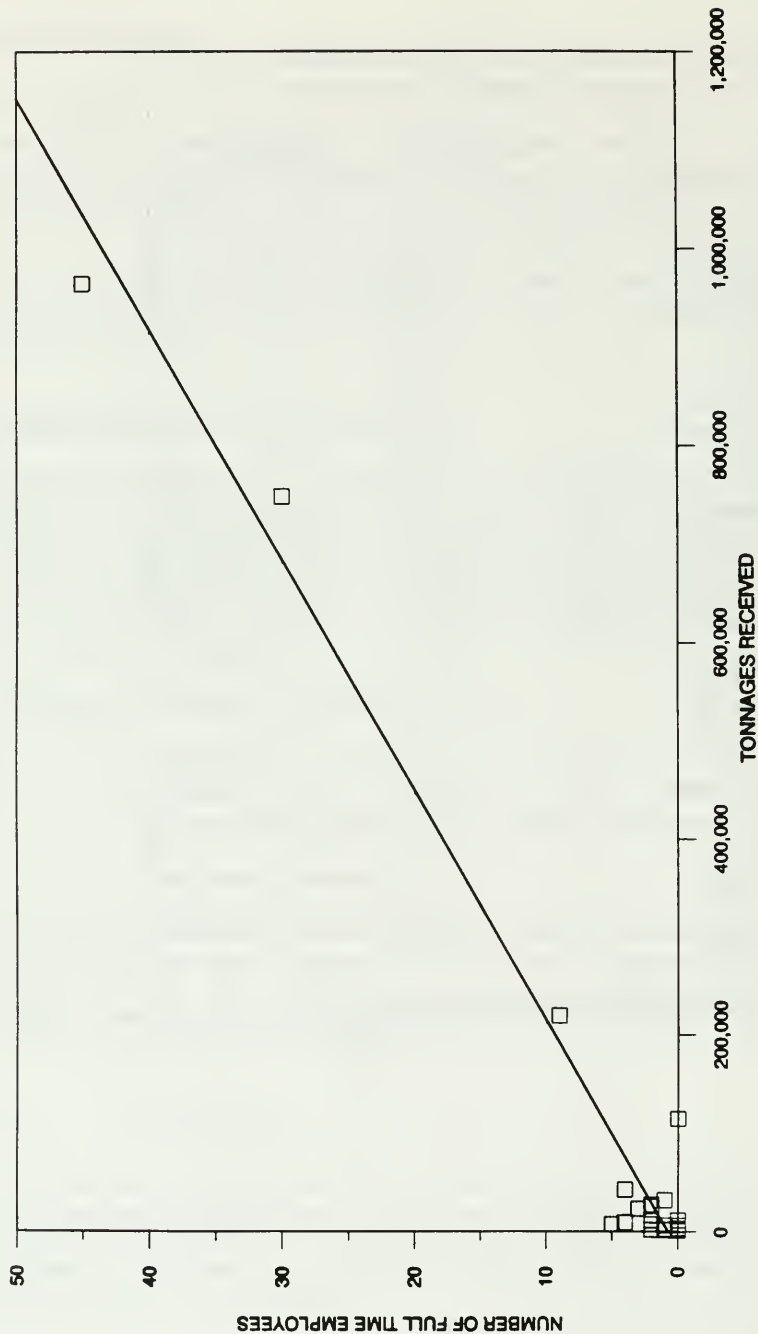


Figure 4.4
COMPARISON OF TONNAGES RECEIVED AND FULL TIME
EMPLOYMENT AT SELECTED LANDFILLS

Table 4.4
GENERIC COST OF LANDFILLING ACTIVITIES FOR
THREE SCENARIOS IN ONTARIO

Landfill Characteristics	Scenario 1	Scenario 2	Scenario 3
Total Capacity (T)	100,000	2,000,000	20,000,000
Avg. Haul Distance (KM)	30	20	20
Soils	Clay	Glacial Till	Glacial Till
Leachate Management	Natural Attenuation	Treat & Pump To Sewer	Treat & Pump To Sewer
Costs	Scenario 1	Scenario 2	Scenario 3
Engineering/Approvals	\$911,405	\$1,443,514	\$2,193,122
Compensation	\$311,405	\$543,514	\$1,193,122
Construction	\$790,950	\$4,146,094	\$24,262,799
Operating Costs	\$247,524	\$2,417,762	\$17,119,344
Equipment Replacement	\$441,088	\$1,114,000	\$1,114,000
Leachate Treatment			
- Capital Costs	\$229,088	\$2,221,906	\$10,146,607
- Operating Costs	\$3,000	\$167,148	\$708,523
Total Site Closure	\$19,460	\$259,324	\$2,709,692
Annual Post Closure Care	\$29,631	\$230,841	\$1,211,234
Required Closure Fund	\$1,084,908	\$10,448,146	\$61,823,712

Source: MacLaren in-house files.

Landfills in Ontario are closing at a steady rate as summarized in Table 4.5 and discussed Section 4.2.2. By 1994, 50% of the landfills that were operating in 1983 will have reached their approved capacity. This trend affects smaller landfills disproportionately; approximately 82% of the landfills expected to reach capacity by 1991 to 1993 accept less than 5,000 tonnes of wastes a year. This trend will also affect large landfills (greater than 50,000 tonnes) namely Brock West, Britannia and Keele Valley, all of which will be closed by 1994.

To date, new approved landfill capacity has lagged behind landfills reaching capacity. However, Waste Management Master Plans are being undertaken in 34 areas covering 75% of the province's population. It is not clear though, whether new capacity will be approved in many areas of the province before existing approved capacity is exhausted.

Table 4.5
REPORTED DATES WHEN ONTARIO LANDFILLS ARE EXPECTED
TO REACH APPROVED CAPACITY

	Size (Tonnes of Waste Accepted Annually)				
	Less than 5,000	5,000 to 10,000	10,000 to 50,000	50,000 to 100,000	Greater than 100,000
End of 1990	128	10	11	1	8
1991 to 1993	80	5	8	1	1
1994 to 2003	124	5	12	2	2
2004 and beyond	85	9	4	2	1
Source: MOE Landfill Site Summary Reports					

There has also been a trend toward larger regional landfills, and away from local community landfills. This is generally done to gain greater control over the management of the landfill and for greater cost effectiveness. Finding a host community for the landfill, however, is becoming increasingly difficult, because although the public has become more informed about waste management issues, and the need for new landfills has gained significant attention, opposition to landfills has grown. Typical public concerns include decreased property values, increased traffic and the resulting dust and noise, wind-blown litter, and pests such as gulls and rats.

There is a trend towards more tightly regulated landfills. This follows from an increased awareness and understanding of the potential environmental damage caused

by landfilling activities. As a result, the landfill approval process has also become increasingly stringent. New landfill designs are required to make provisions for leachate control and monitoring, noise, dust and nuisance control.

Landfill tipping fees have increased in the past 2-3 years and continue to climb. Although some communities are raising their landfill tipping fees to account for specific parts of their waste management costs and possible to encourage diversion from landfill, many are raising their fees to discourage other communities or regions from using their landfills. Smaller communities are reluctant to raise their landfill tipping fees for fear that illegal dumping will occur as a result.

4.3 INCINERATORS

4.3.1 General Description

The objective of incineration is to reduce the volume of the wastes for disposal through controlled combustion. Volume reductions of 80-90% are possible for the combustible portion of the wastes using incineration. This method of waste treatment is costly and, consequently, is often coupled with energy recovery to make the process more economically feasible. In this case, it is referred to as Energy From Waste, or EFW.

Three types of wastes are produced by the incineration process; fly ash, bottom ash and waste gases. Bottom ash is the solid residue remaining following combustion; this ash can be disposed of in a sanitary landfill. Fly ash is the solid residue removed from the combustion gas stream; the status of fly ash is currently under review by the MOE and consequently fly ash must be disposed of at a secure landfill. Figure 4.5 presents a simple schematic of the incineration process.

4.3.2 Physical Dimensions

Currently there are three incinerators in Ontario that accept solid non-hazardous waste. Two of these (3M and Victoria Hospital) are located in London, the third (Solid Waste Reduction Unit or SWARU) is located in Hamilton. A new facility is under construction in Brampton with an anticipated 1992 start-up date. All three existing facilities recover energy from the incineration process. All three existing facilities dispose of their fly ash waste at Laidlaw's secure landfill located in Sarnia. Bottom ash is land-filled locally. All three use fabric filters (i.e. baghouses) to remove dust from waste gases. In addition, 3M and Victoria Hospital operate dry scrubbers to remove unwanted gases, while SWARU uses lime injection (Kiser, 1990). A summary of the physical dimensions of these facilities appears in Table 4.6.

The history of the Commissioners Street Incinerator is also of interest to this study since it operated until August 1, 1988. It's capacity was 900 tonnes per day and it operated 24 hours a day, seven days a week. It accepted domestic and commercial waste

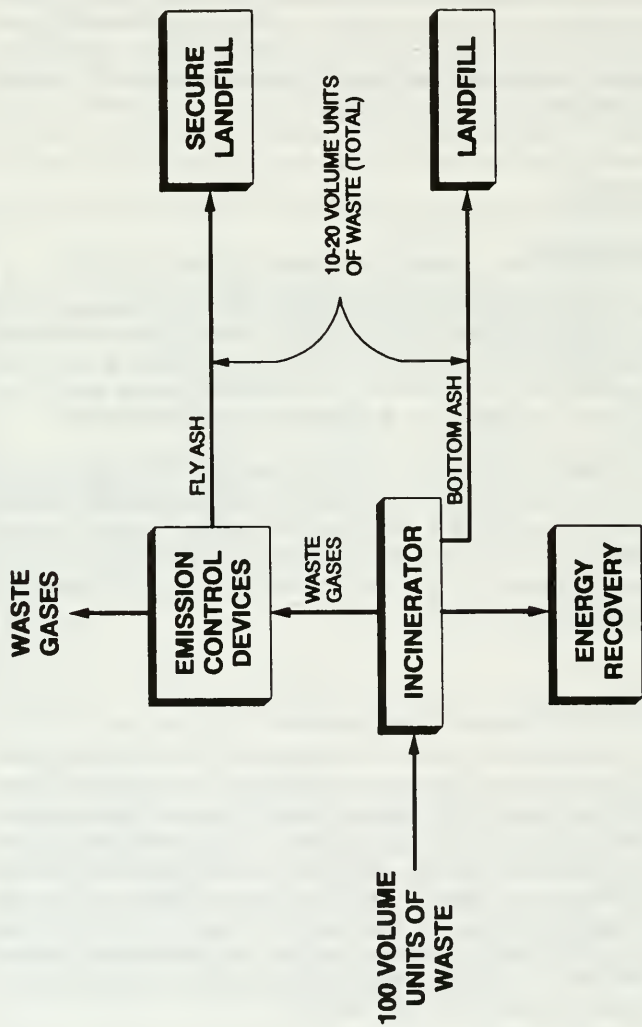


Figure 4.5
INCINERATION SCHEMATIC

Table 4.6
SUMMARY OF PHYSICAL DIMENSIONS OF SOLID WASTE
INCINERATION IN ONTARIO

Incinerator	Waste Source	Tonnage (tonnes/ year)	Employ- ment (full-time)	Use of Energy Recovered	Start-up Year & Comments on Operation*	Design Capacity* (tonnes/day)
SWARU, Hamilton	Approx. 80% of Hamilton and Stoney Creek residential waste. Municipal haulers only.	92,000	40	Electricity sold through Ontario Hydro (4 MW); also steam gener- ation	1972/refitted in 1966	545
3M, London	ICI - commercial waste haulers only.	3,000	5	Heat on-site facilities	1987; shutdowns fre- quent, operate approx. 50 days/yr.	57
Victoria Hospital, London	Approx. 60% of City of London residential waste.	82,000	28	Steam and hydro generation for University of Western Ontario campus	Operating at about 300 t/ day or 75% capacity. Approvals process began in 1983.	272
Sources: <i>Waste Age</i> , 1990* Personal Communication with operator.						

that amounted to about 4% of the solid waste disposed by Metro Toronto, along with solid waste from Pearson International Airport. Ash from the facility (43,453 tonnes in 1986) was hauled to the Brock West Landfill, rather than to a secure facility, as is required for present-day facilities. Full-time staff numbered 65, including supervisory and maintenance staff. Incineration provided for steam generation. The incinerator was closed due to mounting opposition from public interest groups such as Pollution Probe and Citizens For A Safe Environment. They successfully argued that 3R's strategies should be placed ahead of incineration in solid waste management priorities and that more emphasis should be placed on energy conservation rather than on increasing energy supply through refuse incineration.

It should be noted that Ford in Oakville, GM in Oshawa and St. Lawrence Cement all operate their own incineration facilities but do not accept waste from other sources (*Waste Age*, 1990).

Incinerator Tipping Fees

The tipping fee at the Victoria Hospital Incinerator is \$5.68/tonne. The 3M Canada incinerator tipping fee is comparable to the local landfilling tipping fee of \$35/tonne. SWARU charges a tipping fee of \$55 per tonne for municipal wastes.

Incinerator Capital and Operating Costs

Over the past several years, incineration technology has changed and become more complex in response to increasingly stringent air emissions regulations. Incinerators such as SWARU have undergone substantial retrofitting since first being installed, making it difficult to assess complete capital and operating costs. The approach used here is to develop costs based on anticipated technological and environmental requirements for an incinerator built now. Generic capital and operating costs have been developed for EFW plants (see Table 4.7), based on MacLaren in-house files.

Table 4.7 ENERGY FROM WASTE FACILITY GENERIC COSTS			
Capacity			
TPY (tonnes/year)	TPD (tonnes/year)	1990 Capital Cost (x 1,000)	1990 \$/Tonne Operating Cost
113,000	364	53,206	67.50
205,000	660	93,190	63.50
931,000	3000	299,250	43.50

The following factors contribute to capital and operating costs of EFW facilities:

- Number and size of incinerators, boilers and flue gas cleaning devices.
- Trucking of solid waste and ash.
- Staff requirements.
- Plant availability.

4.3.4 Future Trends

Extensive research has been undertaken over the past several years into the environmental impact of incinerator emissions. This research has demonstrated that well operated, state of the art incineration facilities will meet Ontario's air emission regulations. Public uncertainty on this issue remains, however, especially with regard to the formation of toxic compounds such as dioxins which result from the incomplete combustion of plastics.

Incineration remains a relatively costly option for waste disposal in many situations, as indicated by the capital and operating cost estimates presented above. Consequently, landfilling is often more economically attractive as a waste disposal technology.

Provincial policy in Ontario over the last several years has defined a hierarchy of waste management approaches which identifies the 3Rs as environmentally preferable to incineration with or without energy recovery. Since incineration and recycling may compete for the same materials in the waste stream, policies that prefer recycling have tended not to encourage incineration. For example, recycling of the majority of organically-based wastes such as paper and wood may mean that the remaining waste stream has insufficient heating value to support incineration.

In spite of these factors, incineration offers a method of waste disposal that minimizes the land required for landfilling and provides the potential for reliable waste disposal with some level of revenue generation and energy recovery. With rising landfill tipping fees, incineration is becoming more cost competitive with landfills as well. However, operational problems require careful control. For example, feedstream control and maintenance downtime have proven difficult in the past. Nonetheless, incineration is being actively considered as a waste management option in waste management policy studies across the province.

4.4 TRANSFER STATIONS

4.4.1 General Description

Transfer stations are the "middle men" of the waste management system, although they are not included in all waste management systems. Their purpose is to bulk incoming wastes from surrounding areas to reduce costs of hauling the waste to a designated end point, usually a landfill. They have become increasingly important in reducing transportation costs as regional waste management facilities replace local landfills.

Transfer stations range in size and complexity. The simplest transfer station consists of one or more open top steel bins with appropriate access ramps, screening and access control. This type of transfer station is typically located in remote rural locations; in northern Ontario many of these transfer stations fall under the jurisdiction of the Ministry of Natural Resources. Transfer stations located in more urbanized regions of

Ontario can range from a simple concrete dumping platform with a 3-sided windbreak to an enclosed multi-level warehouse facility with a dumping area and sub-floor trailer compactors. The Disco Road transfer station in Etobicoke is an example of this latter type.

4.4.2 Physical Dimensions

The Regional offices of the MOE were contacted as part of the present study to obtain information pertaining to transfer stations within their respective jurisdictions. The Northwest Region office indicated that there are no MOE administered transfer stations located in that region. However there are approximately 28 transfer stations maintained by the Ministry of Natural Resources. No other information was received from MOE Regional offices.

The type of information available from the MOE on transfer stations is limited to Certificate of Approval data, which includes the location of the transfer station. No other information relating to employment, incoming waste or waste sources and destinations is readily available.

Twenty-nine transfer stations were identified in the Waste Management Master Plans. This information was entered into a database file. Table 4.8 provides a summary of the available information on tonnage of waste handled. Unfortunately, no employment data were available from the WMMPs.

More detailed information on Metro's seven transfer stations is provided by a 1986 SWEAP document. Table 4.9 is taken from that report. While it indicates that total employment at all stations (not including Dufferin) was 135 in 1986, recent discussions with Metro Public Works staff indicate that current employment is 212 full-time and 92 part-time (seasonal) staff.

Due to the fact that information on transfer stations is so scant, and wide-ranging, the data cannot be extrapolated to provide general information on the amounts of waste handled or employment at all of Ontario's transfer stations. The information available from the WMMPs has been entered into the database and can be updated as more information becomes available.

4.4.3 Economic Dimensions

Transfer Stations Tipping Fees

Only three transfer stations listed in the WMMPs reported a tipping fee (Windsor, Wellesley, Wilmot). These are all 1984 values and are out of date.

Table 4.8
SUMMARY OF WMMP DATA ON TRANSFER STATIONS

County	Location or Municipality Name	Tonnage (t/yr)
Perth	Mornington	-
Essex	Windsor	84,550
Haldimand-Norfolk	Dunnville	-
Haldimand-Norfolk	Haldimand	-
Haldimand-Norfolk	Nanticoke	-
Haldimand-Norfolk	Norfolk	-
Haldimand-Norfolk	Delhi	-
Parry Sound	Kearney	-
Parry Sound	Healy Lake	-
Frontenac	Kingston	-
Peterborough	Cavan Township	1,800
Simcoe	Adjala Township	-
Simcoe	Tecumseth Township	-
Metro Toronto	Bermondsey (North York)	205,193
Metro Toronto	Disco (Etobicoke)	231,646
Metro Toronto	Dufferin (North York)	124,359
Metro Toronto	Ingram (North York)	357,396
Metro Toronto	Scarborough (Scarborough)	173,169
Metro Toronto	Symes (York)	109,033
Metro Toronto	Victoria Park (North York)	-
Durham	Cartwright	-
Durham	Oshawa	-
Durham	Newcastle	-
Waterloo	Wellesley	-
Waterloo	Wilmot	-

Table 4.9
SUMMARY OF INFORMATION ON METROPOLITAN TORONTO TRANSFER
STATION NETWORK 1986

Metro Transfer Station	Total Waste (tonnes)	Total (t/day)	Source		Major Service Areas	Destination	Total Employ. (b)
			Municipal	Comm/Ind			
Bermondsey	196,450	760	149,617	46,833	East York Scarborough North York Toronto	Brock West	38
Disco	203,370	770	117,942	85,428	Etobicoke	Keele Valley	22
Dufferin (a)	132,594	520	78,112	54,482	North York	Keele Valley	n.a.
Ingram	320,725	1,100	224,943	95,782	York North York Toronto	Keele Valley	16
Scarborough	167,983	600	103,445	64,538	Scarborough	Keele Valley	22
Symes	100,166	390	94,473	5,693	York Toronto	Keele Valley	20
Victoria Park	120,235	460	88,910	31,325	North York Scarborough	Brock West	17
Totals	1,241,523		857,442	384,081			135

Source: SWEAP, Solid Waste Management Base Year 1986, February 1988.

(a) operated by a private firm in 1986 on behalf of MOE

(b) personal communication with Metro Toronto staff

Table 4.10
TRANSFER STATION GENERIC CAPITAL COSTS

Design	Capacity (t/yr)	Capacity (t/day)	Tip Floor (m3)	Facility	Capital Costs		Operating Costs		Haulage Costs
					Peel (000\$/t)	Metro (000\$/t)	Peel (\$/t)	Metro (\$/t)	30-60 km (\$/t)
1 bay	65,000	250	1,100	no building building	1,296 2,500	3,000	5	10	11 to 14
3 bay	200,000	800	4,200	no building building	2,750 5,250	8,000	3.5	7	11 to 14
5 bay	300,000	1,200	8,000	no building building	3,500 8,250	12,000	3.25	6.5	11 to 14

Source: MacLaren in-house files.

Transfer station tipping fees in Metro Toronto somewhat higher than landfill tipping fees, at approximately \$115/tonne (June 1990) and \$175/tonne (1991).

Transfer Station Operating and Capital Costs

Municipalities have made little effort to compile information on the costs associated with transfer stations. In the cases of Simcoe County and Metro Toronto, figures were reported for "total cost" for a number of facilities. It could not be ascertained from the WMMPs, however, what this total cost figure truly represented. Since no assumptions can be made regarding these numbers, they have been reported in the database but not analyzed.

MacLaren transfer station design experience and in-house files were used to develop generic capital and operating costs for transfer stations. Table 4.10 presents capital, operating and haulage costs for transfer stations as a function of the size of the facility. Table 4.11 presents haulage costs from a number of facilities in units of dollars per tonne-minute of operation.

Cost curves prepared by MacLarens for capital and operating costs are presented in Figures 4.6 and 4.7.

**Table 4.11
TRANSFER STATION HAULAGE COSTS**

Source	Haul Costs \$/Tonne*Minute
Peel Master Plan Stage 3 Final Report	0.076 (1989)
Ingram Drive Transfer Station	0.058 (1989)
Halton Region Walker Brothers Occidental Chemical	0.090 (1990) 0.092 (1990)
Source: MacLaren in-house files.	

4.4.4 Future Trends

As landfilling trends move towards the development of more regionalized facilities, transfer stations will play an increasingly important role in waste management systems. Although it is still early to predict trends, transfer stations for recyclable materials can be anticipated. The regionalized nature of material recycling facilities may make such transfer stations feasible for economic reasons.

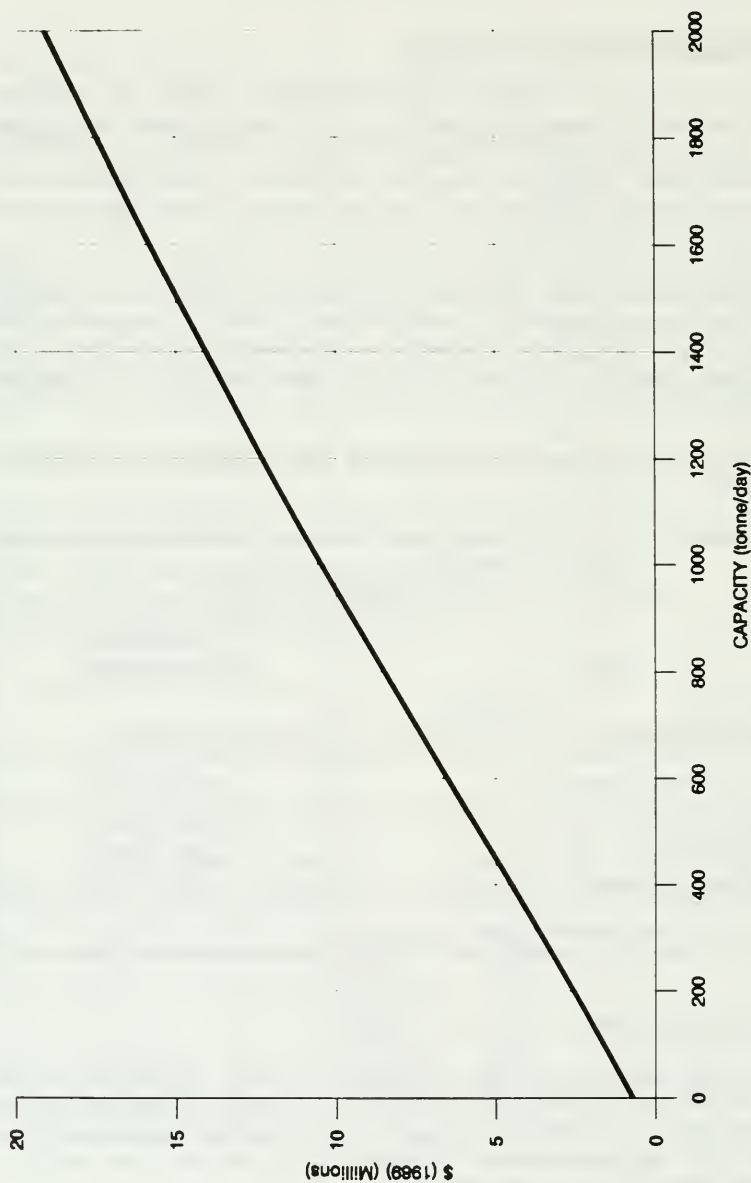


Figure 4.6
TRANSFER STATION CAPITAL COST

**Ref: MacLaren Engineers,
Waste Management Study For
Region of York, 1989**

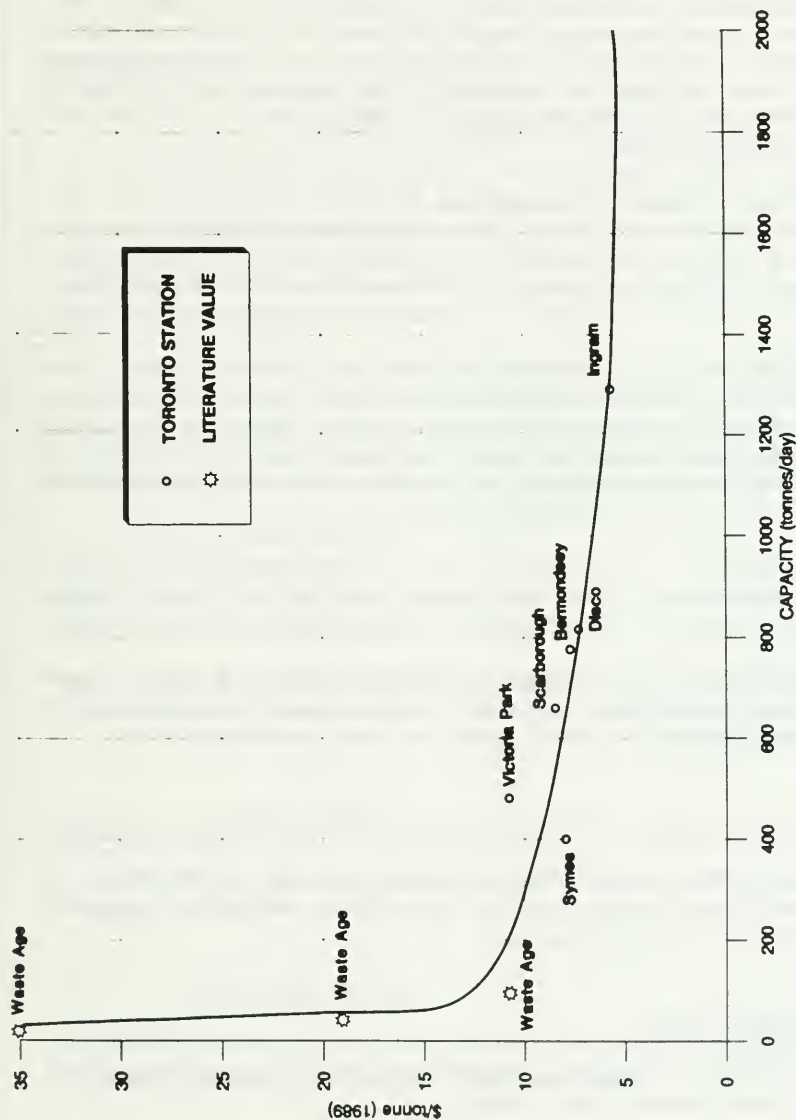


Figure 4.7
TRANSFER STATION OPERATING COST

Ref: MacLaren Engineers,
Waste Management Study For
Region of York, 1989

The solid waste collection and transport industry in Ontario can be divided into two main groups. Traditionally, all such services were performed by the municipality, and in some cases, this remains true today. However, in recent years, many municipalities have begun to contract hauling work to the private sector in the belief that costs will decrease and efficiency will improve. Resistance to this trend has been expressed by public sector labour unions and there remains a mix of approaches to municipal solid waste hauling at the present time.

Data on private sector haulers in Ontario came from three different sources. The principal sources were the 1990 Ontario Waste Management Association members listing and Dun & Bradstreet data on SIC 4953, Refuse Systems, which includes establishments engaged in collection of garbage. The information provided by Dun & Bradstreet includes the results of a telephone survey designed and conducted for this study.

The third data source is the Carriers Database provided in hardcopy format to the study team by the MOE's Approvals Branch. Unfortunately, it has not been possible to reconcile these various sources of information since slight differences in company names and locations make identification of duplicates impossible. Thus each source of information has been examined separately and the results are discussed in the following subsections.

Data collection for public sector haulers focused on employment in Metropolitan Toronto where the majority of public sector hauling takes place and where it remains the most common practice.

Several different types of trucks are common to the hauling industry in Ontario. These are described briefly below. Some have been developed to meet the specific needs of curbside recycling programs.

Front Loading Packer Truck

Fitted with hydraulic hoists to lift metal disposal bins over the front end of the truck and tip them into the top of the container. Separate hydraulic equipment for compacting the waste is also used.

Rear Loading Packer Truck

Container is open at the rear and fitted with hydraulic compaction equipment. Waste is lifted manually to the opening.

Side Loading Packer Truck

Container is open at the top. Hydraulic lifting equipment at the side is designed to lift molded plastic waste containers (residential size) and tip them into the top. Again, compaction equipment is used.

Roll Off Truck

For large volume, usually industrial, wastes which are not readily compacted. Large disposal bins are mounted on the truck trailer, and rolled off at the customer's site using hydraulic hoists. Thus the entire container is left on-site until removal is required. At that time, the entire container is lifted back onto the truck trailer and removed.

Push-out Transfer Trailers

Large trailers commonly used for transporting waste from transfer stations to disposal sites. Large volume containers can accommodate approximately five times the volume of the packer trucks commonly used for collection and transport to transfer stations. In this way, the number of truck movements to the disposal site is reduced. When being loaded, waste is compacted with transfer station equipment. For unloading, hydraulic equipment is used to push waste out of the rear opening.

Closed Body Compartmentalized Top Loading Trucks

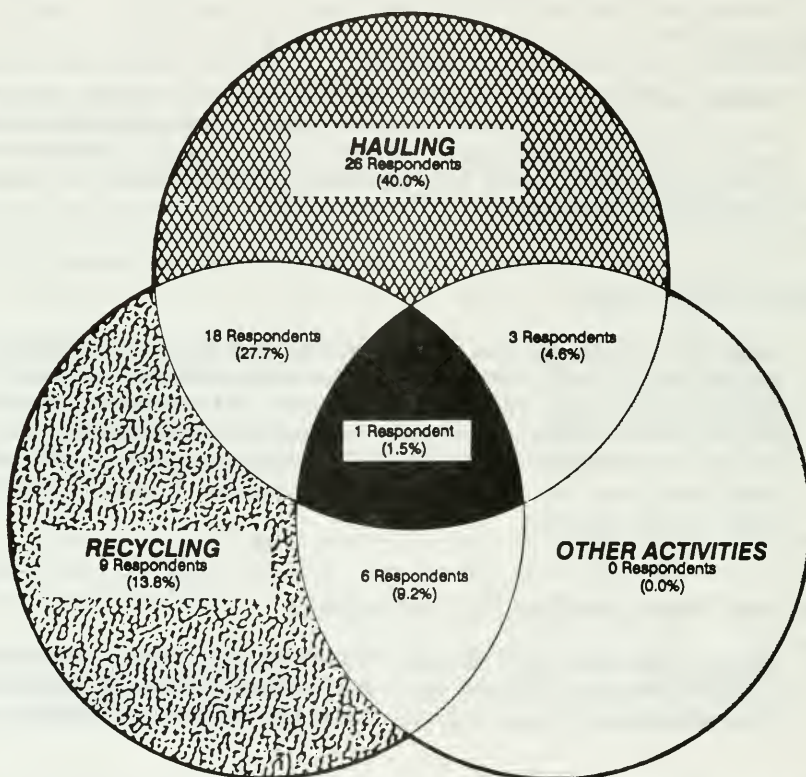
Commonly used in curbside recycling. Hydraulic lifts along the side of the truck are used to lift items to the top, where each is tipped into its own compartment. This achieves some degree of sorting of Blue Box items at the curbside.

Closed Body Compartmentalized Side Loading Trucks

Open-sided truck used in curbside recycling. Separate compartments for recyclables are loaded manually.

4.5.2 Physical Dimensions

The major source of information on private sector haulers of solid waste was a telephone survey conducted by Dun&Bradstreet (D&B) under a subcontract to this study.



NOTES:

- Diagram not to scale, used for illustrative purposes only.
- Data indicate that (2) respondents (3.1%) did not answer questions regarding business activities

Figure 4.8
BUSINESS ACTIVITIES OF
SURVEY RESPONDENTS

The purpose of the survey was to supplement data on physical and economic dimensions available from an already existing D&B database on all SIC groups. A questionnaire was designed by CH2M HILL for the purposes of the survey, a copy of which can be found in Appendix B.

The SIC group of interest in identifying haulers was 4953 (Refuse Systems) which includes those companies engaged in the collecting of garbage. The D&B file on this SIC contains 295 companies in Ontario but includes a wide range of business activities, from landfill operation to dead animal removal. Therefore the first question of the telephone survey asked respondents to define their activities. This also identified recycling agents who are part of this SIC. The results of that aspect of the survey are discussed in Section 5.4. Figure 4.8 gives a breakdown of the activities of survey respondents. The majority of respondents (73.8%) are involved in hauling, but nearly half of these (33.8% of the total) are also involved in recycling or other activities.

The following summarizes the survey response rate:

- 295 companies were on the original list
- 65 (22%) completed the survey.
- 18 (6%) were contacted but refused to complete the survey.
- 55 (19%) were disqualified by Question 1 regarding solid waste handling or recycling activities.
- 42 (14%) of the telephone numbers reached were no longer in service, or the company was no longer in business.
- 45 (15%) of the records were duplicates (e.g., head and regional offices of the same companies). Where possible, responses were sought from head offices.
- 70 (24%) of the companies were not contacted, despite the fact that 3 to 5 calls were placed.

Existing data on companies that did not respond to the survey were provided separately and are discussed at the end of this subsection. The following discussion pertains to those companies responding to the survey.

Existing data on the 65 companies surveyed included employment. For all companies involved in hauling, regardless of any additional activities, 47 of 48 companies (98%) reported employment totalling 792.

Amounts of solid waste *hauled and disposed* in Ontario were solicited. Forty six respondents reported a total 109,297,213 tonnes annually, with one respondent reporting 80,000,000 tonnes and a second reporting 12,000,000 tonnes. CH2M HILL tried unsuccessfully to recontact these companies to clarify their answers. These two responses will be ignored, and limited value is placed on some other responses on waste quantities, as the total quantity of waste generated in the Province is less than 10 million tonnes annually.

Figure 4.9 presents a distribution of the survey respondents by amount of waste reported to be hauled and disposed. It is speculated that the actual distribution of all firms is even further skewed towards small firms since these are more likely to be missed by a database such as the one maintained by Dun&Bradstreet.

An additional question solicited amounts of *recyclable materials hauled* in Ontario. Forty four respondents reported a total of 81,368,991 tonnes annually. The same respondent as previously discussed reported that he hauled 80,000,000 tonnes of material to recycling. It appears that some respondents are reluctant to divulge accurate information on issues related to their market position. This study determined that a total of 486,200 tonnes of material are recycled in Ontario, hence some reported responses to this question are of limited value.

Figure 4.10 presents a distribution of the number of firms by amount of recyclable materials hauled. Once again some of the reported data are inaccurate, and a disproportionately high number of the smaller firms may have been missed in this sampling.

Respondents were asked to name up to ten municipalities served. Results are summarized in Table 4.12. In general, larger municipalities have a larger number of haulers. As expected, some smaller municipalities in the Greater Toronto Area, for example, Newcastle, have a disproportionately high number of haulers.

The sources of solid waste hauled in the private sector in Ontario were also identified. Figures 4.11 to 4.13 present the distribution of the fraction of residential, industrial and commercial sources of solid waste hauled by the private sector in Ontario.

The distributions of the reported prices charged for hauling solid waste from each of these sectors are presented in Figures 4.14 to 4.16. The majority of respondents provided no pricing information. Again, it is assumed that companies felt that pricing information was sensitive. The remaining reported prices are approximately evenly distributed. Unfortunately, however, relatively few respondents reported a price in the appropriate units and it is not clear whether the distributions of Figures 4.14 to 4.16 are truly representative. Because of the competitiveness of the haulage industry it is not surprising that haulers would be reluctant to disclose pricing information which might impact on their competitive edge. No further statistical measures, such as arithmetic mean, were calculated for this reason.

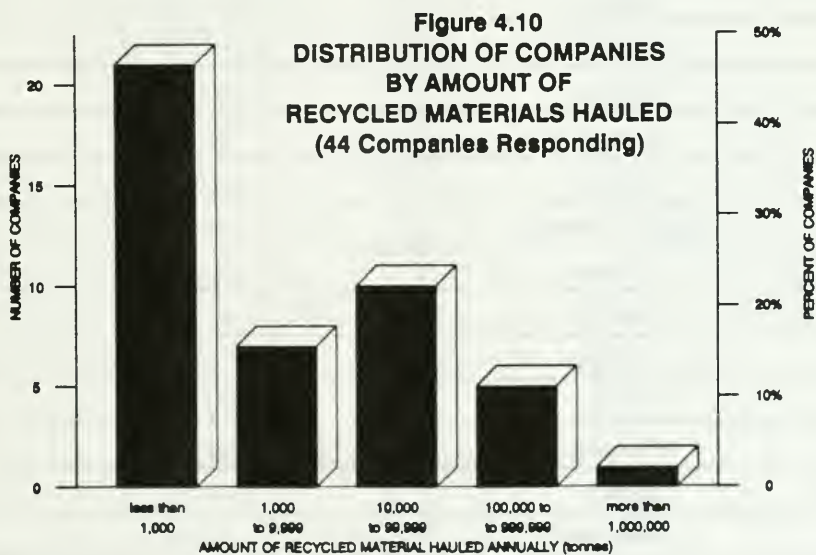
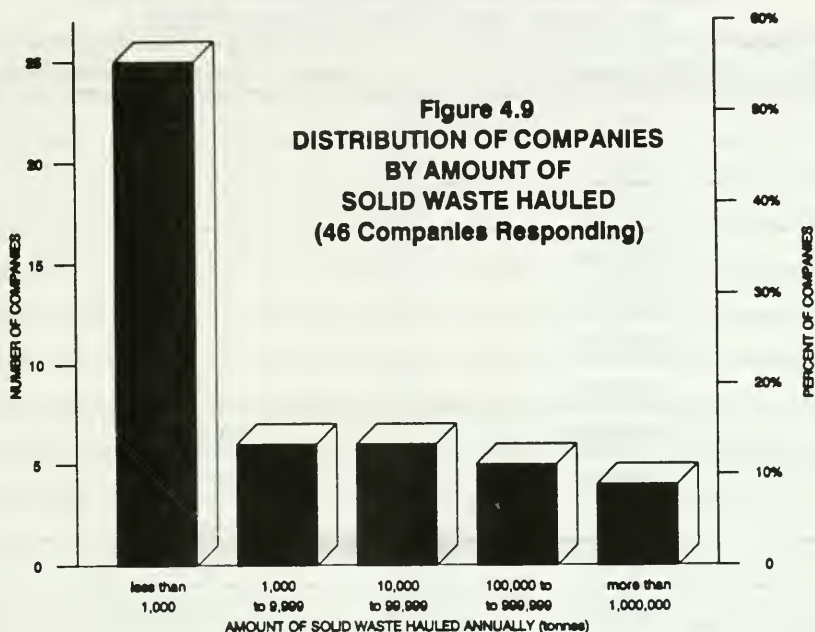


Table 4.12
SUMMARY OF MUNICIPALITIES SERVED BY HAULERS
IN ONTARIO WHO RESPONDED TO SURVEY

Municipality	Number of Haulers Reporting Service
Ajax	6
Barrie	3
Belleville	2
Brampton	8
Brantford	1
Burlington	2
Caledon	2
Cambridge	2
Chatham	1
Cornwall	4
East York	1
Etobicoke	5
Guelph	1
Halton Hills	3
Hamilton	4
Kanata	1
Kingston	2
Kingston Township	1
Kitchener	2
London	3
Markham	1
Milton	2
Mississauga	12
Nepean	1
Newcastle	6

Table 4.12
SUMMARY OF MUNICIPALITIES SERVED BY HAULERS
IN ONTARIO WHO RESPONDED TO SURVEY

Municipality	Number of Haulers Reporting Service
Newmarket	1
Niagara Falls	1
North Bay	1
North York	4
Oakville	8
Oshawa	8
Ottawa	3
Peterborough	2
Pickering	5
Richmond Hill	3
Sarnia	1
Sault Ste. Marie	1
Scarborough	3
St. Catharines	2
Stoney Creek	2
Sudbury	3
Timmins	1
Toronto	17
Vaughan	3
Waterloo	1
Windsor	2
Welland	1
Whitby	4
York	1
Other	6

In many cases, prices, were: reported in units which could not be easily converted to \$/tonne (eg, \$/load); reported as a range; or, simply commented upon (eg, "price depends on contract"). The database of raw data responses has a code to indicate where this occurred.

Figures 4.17 to 4.19 summarize the distributions of the fraction of commercial, industrial and residential sources for the hauling of recyclable materials. Interestingly, these distributions are more clearly weighted in favour of commercial and industrial sources than are the distributions for hauling of solid waste (Figures 4.11 to 4.13).

Information on equipment in use by private sector haulers was also solicited. It would appear that relatively few haulers responded to these questions, but the available information is summarized in Tables 4.13 to 4.19.

Table 4.13 SUMMARY OF INFORMATION ON CLOSE BODY COMPARTMENTALIZED TOP LOADING TRUCKS	
Size	Number of Companies Reporting Use
31 to 50 cubic yards	5
21 to 30 cubic feet	1
31 plus cubic feet	1
less than 10 tons	1
10 to 20 tons	1
Total Reported Number in Use	75

Table 4.14
SUMMARY OF INFORMATION ON CLOSED BODY
COMPARTMENTALIZED SIDE LOADING TRUCKS

Size	Number of Companies Reporting Use
21 to 30 cubic yards	1
31 to 50 cubic yards	2
31 plus cubic feet	1
less than 10 tons	1
Total Reported Number in Use	121

Table 4.15
SUMMARY OF INFORMATION ON FRONT LOADING PACKER TRUCKS

Size	Number of Companies Reporting Use
21 to 30 cubic yards	2
31 to 50 cubic yards	5
31 plus cubic feet	1
Total Number Reported in Use	81

Table 4.16
SUMMARY OF INFORMATION ON REAR LOADING PACKER TRUCKS

Size	Number of Companies Reporting Use
15 to 20 cubic yards	5
21 to 30 cubic yards	9
50 plus cubic yards	1
31 plus cubic feet	1
less than 10 tons	1
10 to 20 tons	2
Total Number Reported in Use	126

Figure 4.11
DISTRIBUTION OF COMPANIES
BY FRACTION OF
COMMERCIAL WASTE

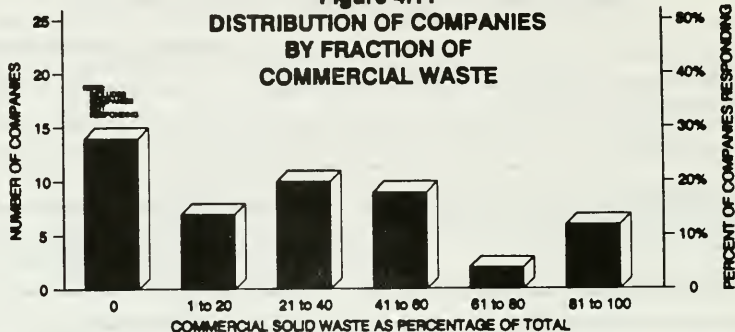


Figure 4.12
DISTRIBUTION OF COMPANIES
BY FRACTION OF
INDUSTRIAL WASTE

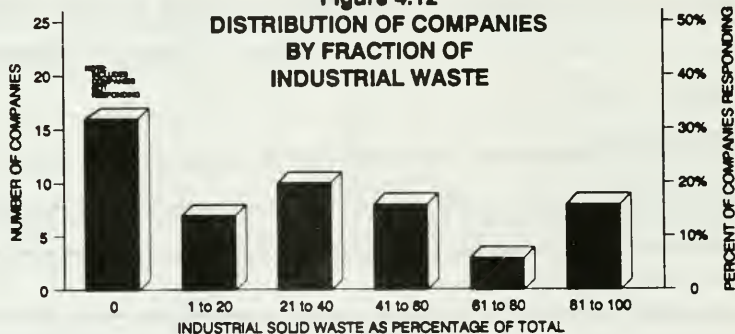
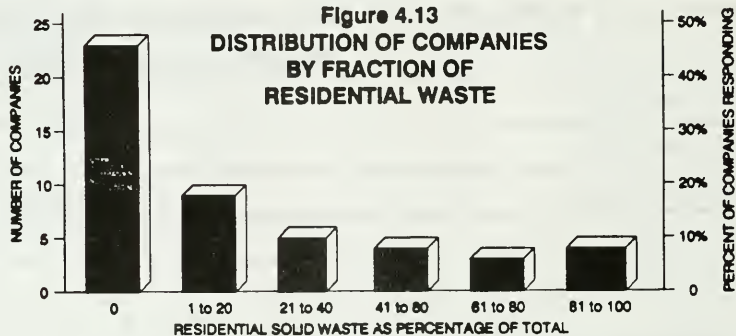


Figure 4.13
DISTRIBUTION OF COMPANIES
BY FRACTION OF
RESIDENTIAL WASTE



NOTE:

- FOR FIGURES 4.11, 4.12, & 4.13, PERCENTAGES ARE BASED ON 48 RESPONSES, 3 OF WHICH DID NOT REPORT NUMBERS TALLING 100%.
- COMPANIES NOT RESPONDING ARE SHOWN IN ZERO COLUMN IN ALL CASES.

Figure 4.14
DISTRIBUTION OF COMPANIES
BY PRICES CHARGED
FOR HAULING COMMERCIAL WASTE
(22 Companies Responding)

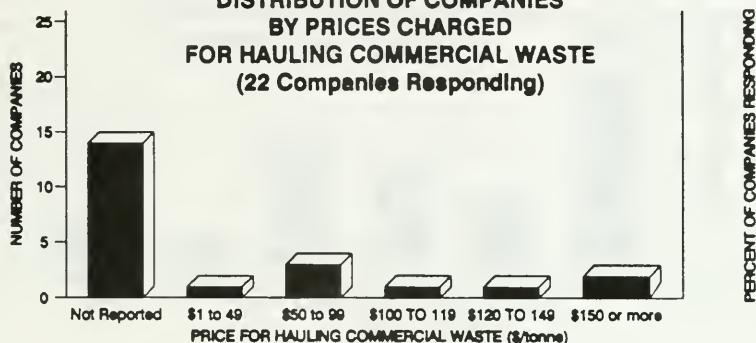


Figure 4.15
DISTRIBUTION OF COMPANIES
BY PRICES CHARGED
FOR HAULING INDUSTRIAL WASTES
(28 Companies Responding)

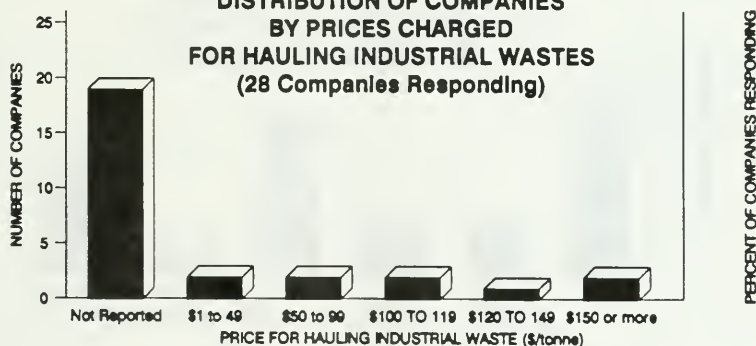
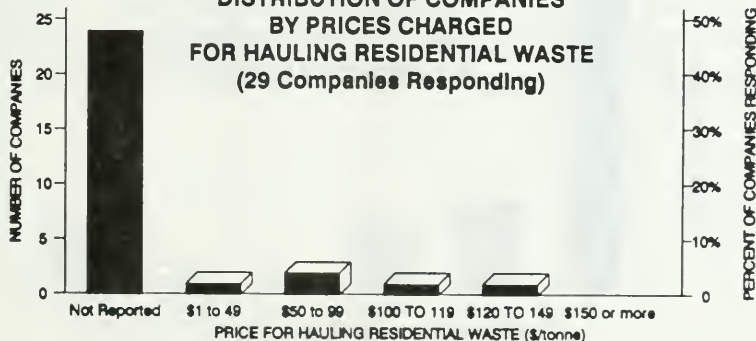


Figure 4.16
DISTRIBUTION OF COMPANIES
BY PRICES CHARGED
FOR HAULING RESIDENTIAL WASTE
(29 Companies Responding)



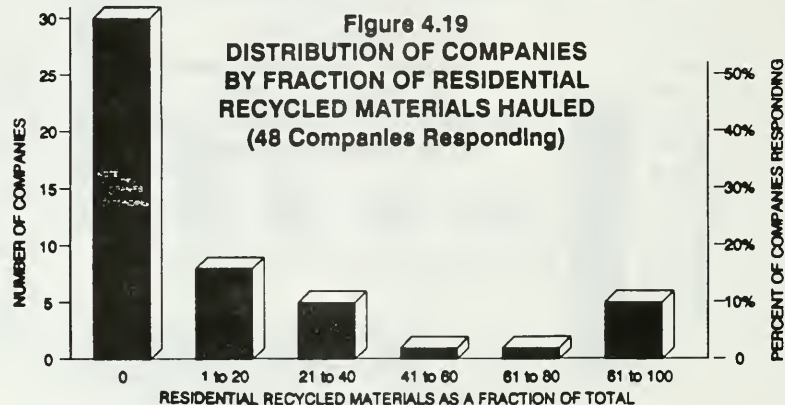
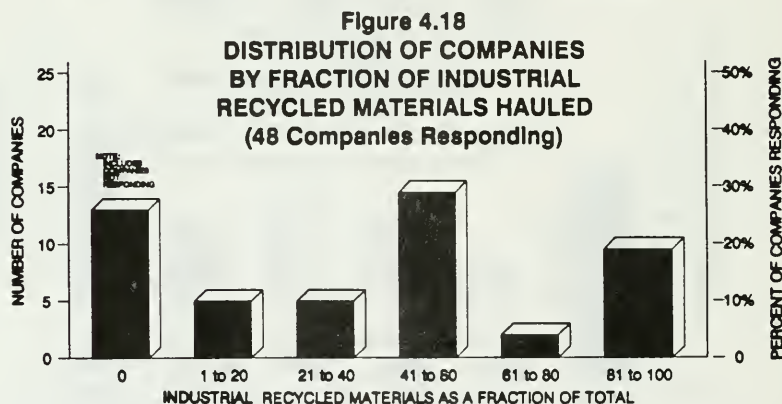
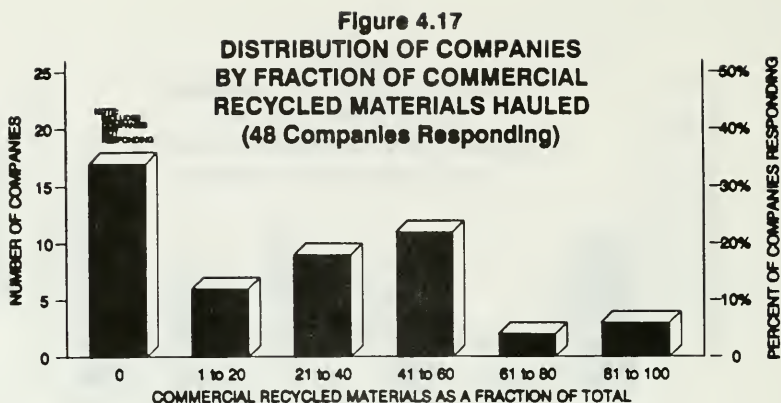


Table 4.17
SUMMARY OF INFORMATION ON SIDE LOADING
PACKER TRUCKS

Size	Number of Companies Reporting Use
15 to 20 cubic yards	3
21 to 30 cubic yards	1
31 plus cubic yards	1
21 plus tons	1
Total Number Reported in Use	5

Table 4.18
SUMMARY OF INFORMATION ON
ROLL OFF TRUCKS

Size	Number of Companies Reporting Use
Less than 15 cubic yards	1
21 to 30 cubic yards	2
31 to 50 cubic yards	6
31 plus cubic feet	1
Less than 10 tons	3
10 to 20 tons	2
21 plus tons	5
Total Number Reported in Use	284

Table 4.19
SUMMARY OF INFORMATION ON OTHER TRUCKS

Size	Number of Companies Reporting Use
Less than 15 cubic yards	3
21 to 30 cubic yards	1
Less than 10 tons	1
10 to 20 tons	2
Less than 3,500 gallons	2
3,500 plus gallons	1
Total Number Reported In Use	967

Existing D&B database information on the 230 companies which did not respond to the survey was also obtained. Note, however, it is not necessarily possible to ascertain from this information whether any particular firm is involved in hauling. Of these 230, 54 indicated their primary occupation was garbage collection or trucking, while an additional 91 described their main activity as refuse systems, which presumably may include waste hauling. Table 4.20 summarizes information on employment under both of these activities.

Table 4.20
SUMMARY OF EMPLOYMENT FOR COMPANIES NOT SURVEYED

Primary Activity	Number of Companies	Number of Companies Reporting Employment	Percentage of Companies Reporting Employment	Total Reported Employment
Garbage Collection or Trucking	54	54	100	1,383
Refuse Systems	91	89	98	594

It is interesting to note that only two of the 230 companies not surveyed listed Scrap and Waste Material Wholesale (SIC 5093) as a secondary activity. Many of the 230 companies were branch offices of some of the large hauling companies in Ontario. Nine of the listings were for BFI (Browning-Ferris Industries Ltd.), eleven were for Laidlaw Waste Systems Ltd., and seven were for Tricil Limited.

The database of Ontario Waste Management Association member information has 123 records. Information from the Association indicates that together these haulers handle more than 85% of the province's solid waste. 98 of these companies report hauling of residential and ICI solid waste. Of these, 69 (70%) haul both residential and ICI, 70 (71%) haul residential and 97 (99%) haul ICI. Eleven (11%) own and/or operate landfills, 14 (14%) own and/or operate transfer stations, and 43 (44%) are involved in recycling. Tricil of Sarnia (now owned by Laidlaw Waste Systems Limited) owns and operates an incinerator for destruction of liquid and hazardous wastes only.

The MOE Approvals Branch Carriers Database lists haulers holding MOE Certificates of Approval (C of A). Information includes C of A number, type of wastes handled and which of six MOE provincial regions are served. It thus may contain many companies which carry, for example, only liquid industrial or hazardous waste and do not carry municipal solid waste. However, since these data were not available in electronic format to the study team, no further analysis was possible. The database appears to contain more than 3,000 records, however, once again it was not possible to ascertain whether the same company may hold more than one C of A, nor whether the listing contained duplicates.

Some municipalities still maintain their own staff and equipment to collect and haul solid waste. In Regional Municipalities, collection is the responsibility of the municipality, while disposal is under regional jurisdiction. A telephone survey of Metropolitan Toronto municipalities was conducted to establish typical staffing requirements. Results are summarized in Table 4.21.

4.5.3 Economic Dimensions

Annual sales figures for twenty nine (29) haulers totalled \$54,567,500 in the database of existing data from Dun&Bradstreet. However, since many haulers are also involved in other activities, the survey solicited information on what fraction of sales were attributed to hauling. Figure 4.20 presents the distribution of responses.

In addition, responses were sought as to what fraction of business is conducted in Ontario. These results appear in Figure 4.21.

Table 4.21
SUMMARY OF SELECTED MUNICIPAL EMPLOYMENT FIGURES
FOR SOLID WASTE COLLECTION AND HAULAGE

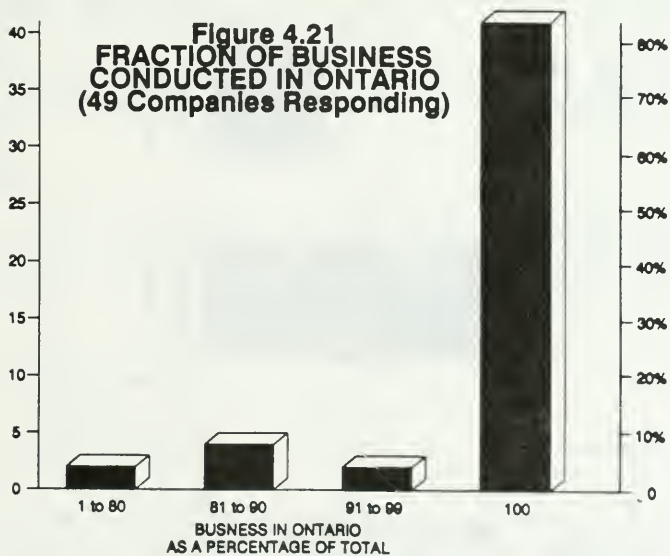
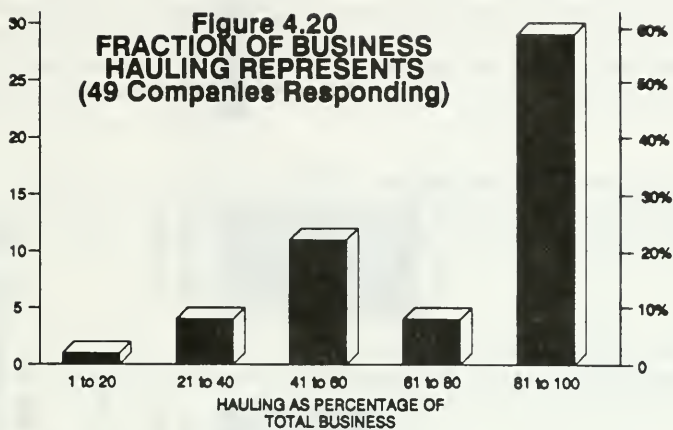
Municipality	Garbage (Perm)	Recycling (Perm)	Other (Perm)	Other (Temp)	Total (Perm)	Total (Temp)
East York	45	10			55	
Etobicoke					106	10
North York	165	24	14		203	
Scarborough	114	26		18*	140	
Toronto					400	
York					60	
* These 18 employees work for a private company contracted to Scarborough to provide "on-call" staffing.						

A distribution of operating costs was also developed (Figure 4.22).

Again, information on the companies not surveyed is also available. Haulers may fall under a number of categories in this SIC, including Garbage Collection and Refuse Systems. Sales figures for these categories are summarized in Table 4.22.

Table 4.22
SUMMARY OF ANNUAL SALES FIGURES FOR COMPANIES
NOT SURVEYED

Primary Activity	Number of Companies	Number of Companies Reporting Sales Figure	Percentage of Companies Reporting Sales Figure	Total Reported Sales Figures
Garbage Collection or Trucking	54	15	28	\$36,338,900
Refuse Systems	91	39	43	\$11,949,600



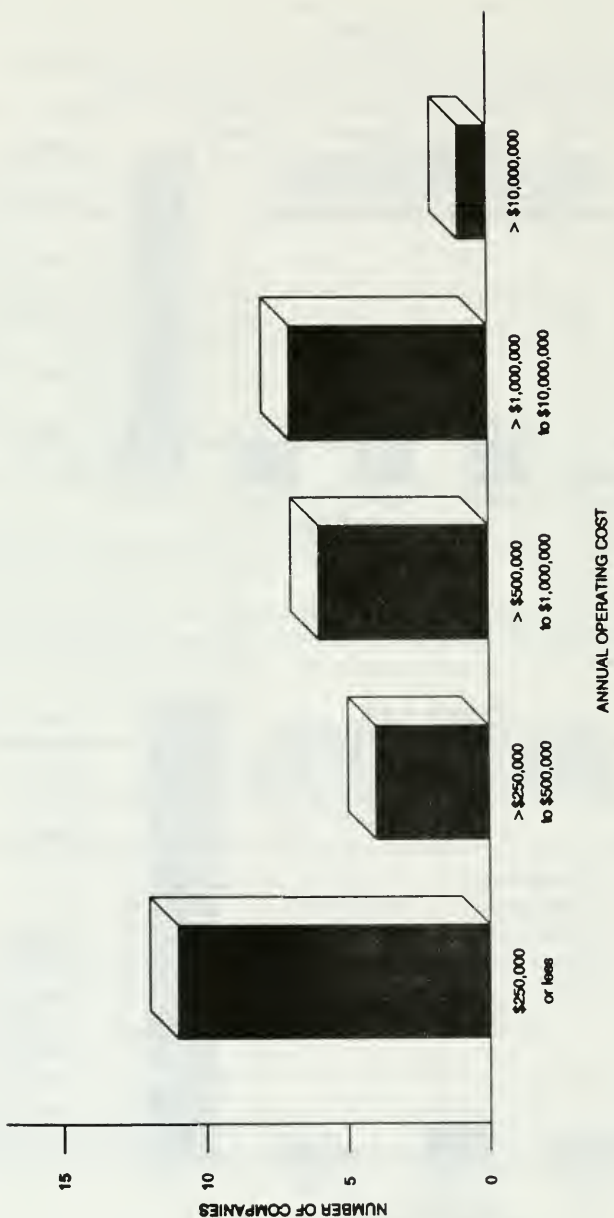


Figure 4.22
DISTRIBUTION OF COMPANIES BY
ANNUAL OPERATING COSTS
(29 Companies Responding)

4.5.4

Future Trends

In general, it is difficult to generalize on future trends in the hauling business since they will be highly dependent on policy initiatives related to reduction/reuse/recycling strategies. For example, if the focus of policy is waste reduction, the total amount of waste requiring handling may decrease, resulting in decreased hauling. On the other hand, if recycling activities continue to increase, so-called double handling of wastes may increase as they are moved between generators, various recycling agents and the end user, resulting in increased hauling.

Two questions in the telephone survey addressed respondents' opinions of future trends in the hauling business. It should be noted that responses to such questions tend to be somewhat overly optimistic, but they do serve to reflect the overall business climate.

Question 4 read:

In the future, as more waste reduction, reuse of materials and recycling programs are implemented, how do you see the growth of your business? Do you think your business will have:

- 1) Substantial growth
- 2) Slight growth
- 3) Stay the same
- 4) Slight loss of business
- 5) Substantial loss of business

Figure 4.23 summarizes the forty nine responses received in pie chart form. More than 70% of haulers expect slight or substantial growth in the future. Less than 15% expect any losses.

Question 5 read:

In the future, as more waste reduction, reuse of materials and recycling programs are implemented, how do you see your company's costs changing? Do you think your business costs will have:

- 1) Substantial increase
- 2) Slight increase
- 3) No change
- 4) Slight decrease
- 5) Substantial decrease

Figure 4.24 presents a pie chart representing the forty nine responses. Nearly two-thirds of all respondents believe that haulage costs are likely to increase with new policy initiatives. Notably, however, a total of more than 20% anticipate lower costs.

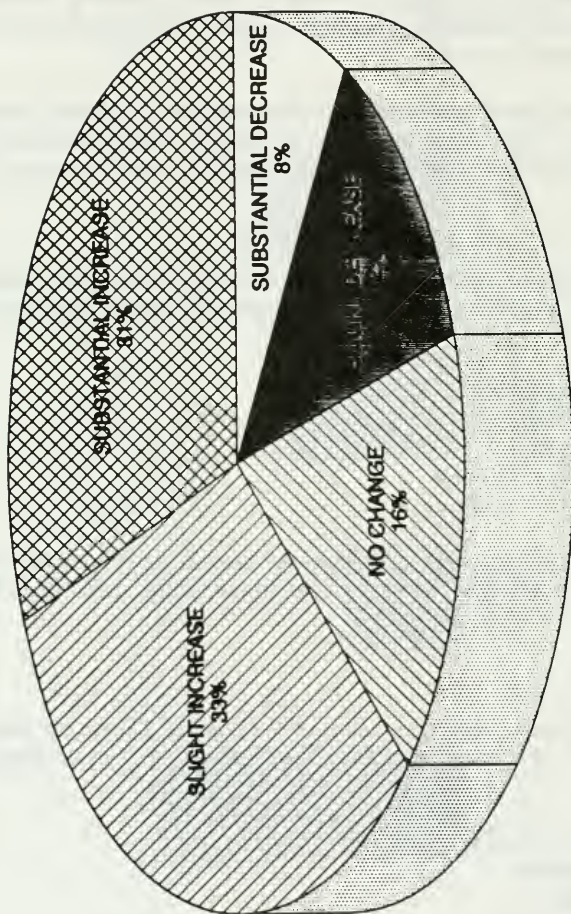


Figure 4.23
ANTICIPATED BUSINESS COSTS

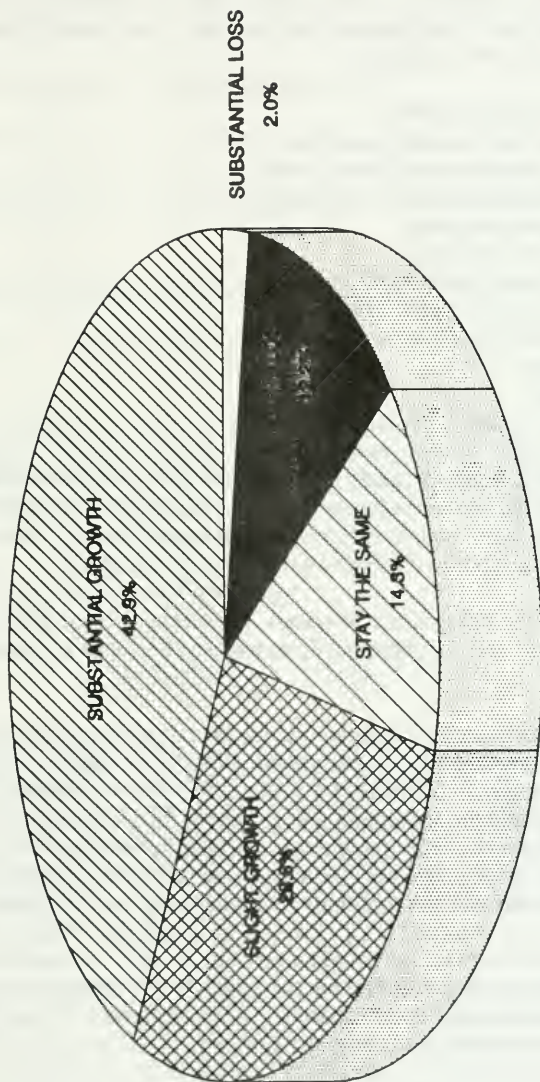


Figure 4.24
ANTICIPATED BUSINESS GROWTH

4.6

ENVIRONMENTAL PROTECTION INDUSTRY

4.6.1

General Description of Industry

A report to the Ministry of the Environment on the Environment Protection Industry in Ontario was completed by Woods Gordon in May 1989. The industry was reported to employ 28,000 people in 1,700 firms in the Province. The broadly defined sector includes the following twelve categories:

- 1) Consulting/engineering
- 2) Air pollution control equipment
- 3) Water pollution control equipment
- 4) Other pollution control equipment
- 5) Treatment chemicals
- 6) Solid waste handling
- 7) Liquid waste handling
- 8) Waste treatment and disposal
- 9) Laboratory
- 10) Recycling
- 11) Training
- 12) Biotechnology

Of these, only groups (1), (6), (8) and (10) would be of interest to the present study. The EPI study figures did not include municipal or government employees, and therefore did not cover the many people employed by municipalities to collect and recycle garbage, and to operate landfills, transfer stations and incinerators.

In any event, much of the physical and economic information required for this study on public, private and third sector solid waste management has been collected from other sources.

The EPI Sourcing Database created as part of the Woods Gordon study has been provided to the study team by the Ministry of Industry, Trade and Technology. It contains the listing of approximately 1,700 firms in the Ontario EPI as identified by Woods Gordon. It does provide some limited capabilities to search for information on the services provided, based on keywords. However, these searches appear to be of a type known as character or literal string searches, and, as such, no summary analysis of the data is possible in its present format. In addition, no information on the physical and economic dimensions of the companies are provided. Although the Woods Gordon report refers to economic spreadsheets developed to model the EPI, known as the Environmental Protection Impact Model, these are not contained in the database provided by MITT. For completeness' sake, the database of EPI companies is being included in the study database, even though it is not in dBASE format.

Possible alternative sources of information on the EPI are being developed by other government agencies. The agencies involved are:

1. Ministry of Industry, Trade and Technology (Ontario)
2. Industry, Science and Technology (Canada) - federal and regional offices
3. Statistics Canada - Environmental Statistics
4. Environment Canada - Solid Waste Management Branch

The following paragraphs summarize the current status of information gathering.

1. **Ministry of Industry, Trade and Technology**

Contact: David Reid, Domestic Industries, Environmental
(416) 324-6736

MITT are developing what is known as the Environmental Industries Sourcing Database. However, it is considered to be in the prototype stage only. In addition, much of the information is commercially confidential. Some aggregated data may be available at a future date, if formally requested, to provide an economic profile of the industries.

2. **Industry, Science and Technology**

Contact: Derek Yue, Toronto Regional Office
(416) 973-5159

IS&T (Ottawa) are working on the Environmental Industries (EI) Initiative. As such, regional offices have access to some initial results of a broad-ranging survey conducted by Corpus (Southam). This consists of an 80 page listing of company names for Ontario (approximately 1,600 names). However, this list is not specific to solid waste management and there is no company services listing included. Another responsibility of the EI Initiative is to improve Canadian SIC's to better reflect the EPI. The contact name in Ottawa is: John Moran, Chairman, Economic Characteristics Working Team, EI Initiative, (613) 954-6181.

The BOSS database system was also developed in Ottawa. It is available free from the Toronto Regional Office on floppy disk and was developed to serve manufacturers by providing a list of suppliers. It is updated periodically by mail-out survey. If a company fails to respond for three years, it is dropped from the listing. However, IS&T is hoping to expand this database because it is not comprehensive at this time.

3. Statistics Canada

Contact: Kirk Hamilton, Environmental Statistics
(613) 951-8585

StatsCan is in the process of drafting a survey which is to be partially funded by IS&T's EI Initiative. It addresses haulers and recycling agents in the private sector. The survey will be sent out sometime in November with data available around March 1991. A final published report would be expected sometime later in the spring.

The questions cover the following economic dimensions:

- Revenues for each of the activities (eg, hauling, disposing, hauling to a recycler, sorting, etc.).
- Operating cost structures (eg, fuel, labour, etc.).
- Number of employees.
- Quantities of materials (eg, hazardous, non-hazardous wastes, etc.).
- Fate of materials (eg, landfill, incineration, chemical or biological treatment, etc.).
- Quantities of materials recycled (eg, paper, aluminum, steel, etc.).
- Total investments.

The survey is being aimed at larger private firms throughout Canada. Data collected will be organized in a database format that will provide for provincial breakdowns where confidentiality allows.

A parallel survey of public sector waste management is now being discussed with the Public Institutions Division of StatsCan (contact: Rob Loggie - (613) 951-1809). This will provide for a comparable set of questions to the private sector survey described above, as well as names of private firms contracting to municipalities as a cross-reference to the private sector data. Data from that survey may be available at about the same time as the private sector survey.

4. Environment Canada

Information from MITT indicates that Environment Canada has conducted some EPI surveys through Dun & Bradstreet, however, the results may have been less than comprehensive. A possible contact there is: Dave Hay, Solid Waste Management Branch, (819) 953-1109.

4.6.2

Physical Dimensions

As noted above, the Woods Gordon study estimated the size of the entire EPI sector to be approximately 28,000 employees. This includes employment in the solid and hazardous waste, air quality and water and wastewater treatment areas, the latter two of which are not of interest to this study. Unfortunately, the study did not provide a breakdown of total employment for the solid and hazardous waste services sector. In the mail survey conducted for the study, 64 respondents in the solid and hazardous waste area accounted for a total of 2,738 employees.

The 1990 annual directory from the Ontario Waste Management Association provided a listing of equipment manufacturers and distributors. This information has been summarized in a database format (file name EQUIP.DBF), listing 44 companies. Company addresses and phone numbers as well as listings of the type of equipment supplied is provided. It should be noted that it appears that the majority of these companies are distributors only, and that very little manufacturing takes place in Ontario. However, no specific information of this nature is contained in the database. Nor is there any information on size of the companies (i.e. number of employees, etc.).

The industry journal Waste Age routinely publishes buyers' guides for various manufacturers of solid waste management equipment. These guides generally list only address and telephone number for the head office for each company. Thus branch manufacturing plants which may be located in Ontario are not included. Table 4.23 summarizes information from recent guides on numbers of manufacturers in total, in Canada and in Ontario. With the possible exception of curbside recycling containers, the vast majority of equipment is manufactured in the United States and is imported for distribution in Canada.

4.6.3

Economic Dimensions

The only source of economic information related specifically to the EPI was found in the Woods Gordon report. To briefly summarize, Table 4.24 presents the Woods Gordon survey results for reported sales of Ontario EPI solid and hazardous waste disposal and treatment goods and services for 1987.

As noted above, all the Woods Gordon data exclude services provided by governments directly, and for the solid waste field these may represent a substantial fraction of the activity in the sector.

The total 1987 revenues of the EPI are also estimated, as summarized in Table 4.25.

Table 4.23
SUMMARY OF INFORMATION FROM
WASTE AGE MANUFACTURERS GUIDES

Guide/Item	Reference	No. of Ontario Manufacturers	No. of Cana- dian Manuf.	Total No. of Manufacturers
<i>I. Recycling Containers</i>	7			
curbside depot		5 0	6 0	40 17
<i>II. Refuse Containers</i>	2			
containers		0	1	32
barrels		0	0	15
costers		0	0	8
covers/lids		0	0	19
decals		0	0	6
delivery carriers		0	0	6
liners		0	0	3
<i>III. Waste Processing Equipment</i>	5			
can densifiers		0	0	12
conveyors		0	0	31
glass crushers		0	0	13
screens & trommels		0	0	7
magnetic separators		1	1	10
shredders		2	2	43
storage & retrieval bins		0	0	4
wood waste grinders		0	0	7
<i>IV. Baling Equipment</i>	3			
horizontal balers		0	0	17
vertical balers		0	0	16
baling wire suppliers		0	0	20
bale tying equip- ment		0	0	8
<i>V. Stationary Compactors</i>	1	2	5	50
<i>VI. Transfer Trailer</i>	6			
trailers		2	4	36
tarps		0	0	10
yard jockeys		0	0	7
<i>VII. Landfill Equipment</i>	4	1	1	16

Table 4.23
SUMMARY OF INFORMATION FROM
WASTE AGE MANUFACTURERS GUIDES

Guide/Item	Reference	No. of Ontario Manufacturers	No. of Cana- dian Manuf.	Total No. of Manufacturers
References:				
1.	Waste Age, July 1990. 1990 Stationary Compactor Byers Guide, pg. 121.			
2.	Waste Age, July 1990. 1990 Refuse Containers and Accessory Guide, pg. 131.			
3.	Waste Age, August 1990. 1990 Baling Equipment Guide, pg. 161.			
4.	Waste Age, August 1990. 1990 Landfill Equipment Guide, pg. 161.			
5.	Waste Age, September 1990. 1990 Waste Processing Equipment Guide pg. 161.			
6.	Waste Age, September 1990. 1990 Transfer Trailer and Accessory Guide, pg. 171.			
7.	Waste Age, October 1990. 1990 Recycling Containers Guide, pg. 155.			

4.6.4

Future Trends

Woods Gordon also commented on a number of future trends. As government requirements become more stringent, survey respondents anticipate annual growth rates of greater than 15%. Free trade with the United States is expected to be modestly beneficial to manufacturers and consultants who are in a position to export. However, high technology items and general industrial goods are largely imported.

Survey respondents in the Woods Gordon study made comments related to the effects of government policy on industry prospects. In general, purchasers of EP goods and services believe they will be able to meet more stringent environmental protection regulations as long as they don't exceed American requirements.

On the other hand, suppliers in the EPI feel that if government policy played a leading role, rather than following the U.S., development of innovative EP goods and services would be stimulated, and future export opportunities maximized. Suppliers favour increased government support for R&D and greater flexibility in approvals for pilot projects.

Table 4.24
REPORTED SALES OF WASTE DISPOSAL AND TREATMENT
GOODS AND SERVICES, ONTARIO, 1987

Product/Service	Number of Firms	1987 Sales
Equipment/ Instruments/Supplies	21	\$30,376,980
Solid/Hazardous Waste Disposal and Destruction Services	16	\$129,506,791
Recycling Services	12	\$145,799,246
Consulting, Other Services	34	\$20,271,820
Total	83	\$325,954,837

Table 4.25
**ESTIMATED 1987 REVENUES OF THE ONTARIO ENVIRONMENTAL
 PROTECTION SECTOR**

Commodity	Estimated 1987 Revenues
Machinery, Equipment, Instruments, Supplies	\$250 - \$400 million
Recycling Services	\$500 - \$1,000 million
Waste Disposal and Destruction Services	\$300 - \$400 million
Construction Services	\$350 - \$500 million
Consulting Engineering and Analytical Services	\$100 - \$200 million
Total	\$1.5 - \$2.5 billion

Section 5

PHYSICAL AND ECONOMIC DIMENSIONS OF WASTE RECYCLING

5.1 GENERAL

The recycling of waste materials is a component of the waste management system whose importance and impact has increased dramatically in the last few years. This has been prompted to a great extent by a projected shortfall in landfill capacity as well as increased awareness on the part of the public, municipalities and the ICI sector, that many waste materials are resources which can be put to useful purpose, and landfilling them does not realize their full potential. Also, tipping fees have increased to a point where recycling is more economically viable than it was a number of years ago. Figure 5.1 shows how the various components of the recycling system interact. This Section describes the present physical and economic dimensions of recycling in Ontario under three main headings, namely:

- Recycling Programs
- Material Recovery Facilities (MRFs)
- Private and Third Sector Recycling Agents (Recyclers)

5.2 RECYCLING PROGRAMS

5.2.1 The History of Recycling in Ontario

Ontario's Blue Box recycling program, recognized world wide for its ingenuity, has evolved from a drop-off depot strategy to a comprehensive curbside collection program. The program's momentum has carried it beyond the curbside program to include multi-unit buildings, rural areas and schools.

Prior to 1980, recycling was characterized as a short-term, often single material business venture that responded to the demands of the end-user market. The appearance of depots and buy-back centres fluctuated with the demand and price for a secondary material. Programs were generally operated by either small entrepreneurs who capitalized on the short-term financial potential of the recycling industry or non-profit organizations, who became involved in recycling for fundraising purposes. Due to the sporadic nature of the business, securing a reliable, stable recycling industry became a difficult task.

A number of events helped shape the future of the Blue-Box recycling program. In the early 1980s The Ministry of the Environment published the report, A Blueprint for Waste Management in Ontario, which communicated its commitment to pursuing the 4R (reduce, reuse, recycle, recover) hierarchy approach to waste management.

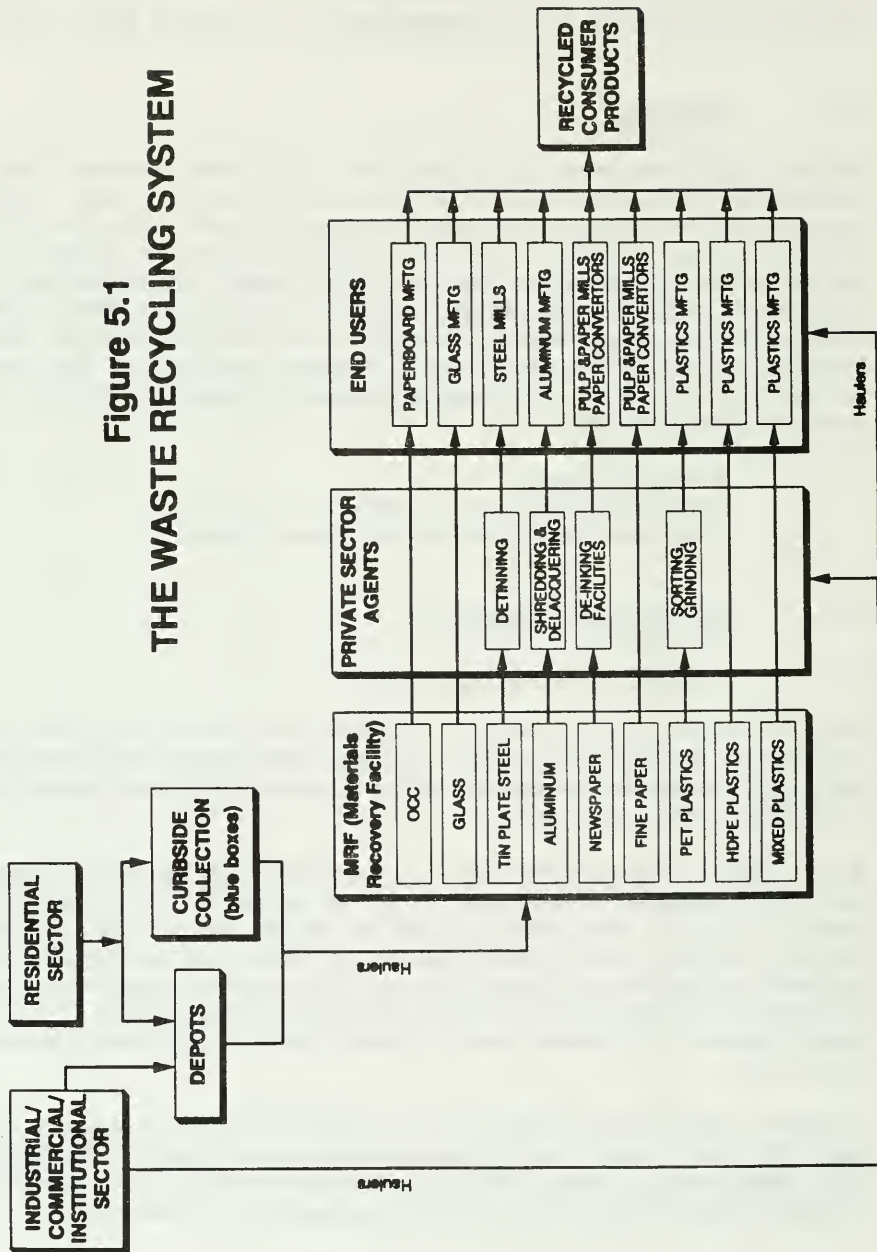


Figure 5.1
THE WASTE RECYCLING SYSTEM

Concurrent to the publication of the report, the City of Kitchener, aided by Laidlaw Waste Systems Inc., launched its successful curbside recycling program. Initiated as a pilot feasibility project, enough public support and pressure was exerted on the City Council of Kitchener that a full-scale program was introduced in 1983. For the first time, the program operator secured a commitment from Quebec and Ontario Paper Company to accept all of its old newspapers over a continuous period of time. With this commitment the foundations for a stable recycling infrastructure had been laid.

The recycling market was further strengthened with the introduction of the amended Soft Drink Container Legislation by the Ministry of the Environment in 1985. This piece of legislation aimed to encourage full-scale recycling of soft drink containers in Ontario by balancing the sales of nonrefillable containers with the sales of refillable containers. As recycling rates for nonrefillable soft drink containers reached the 50% mark, then the number of refillable containers designated for sales would be reduced. The most effective means of achieving the 50% recycling rate was determined by the advisory group, the Recycling Advisory Committee (RAC). RAC determined that a minimum 50% recycling rate could be met by providing 50% of Ontario's single-family households with a Blue-Box container and the opportunity to participate in the curbside collection recycling program.

Following closely on the heels of RAC's formation, the soft drink industry and related associations established Ontario Multi-Material Recycling Incorporated (OMMRI) in 1987 to oversee the implementation of the Blue Box program in Ontario. Funding programs, based on a cost-share approach, enticed municipalities to initiate curbside programs. Essentially, one-third of the capital costs incurred by the municipality were paid for by OMMRI and the remaining two-thirds of the costs were split between the Ministry of the Environment and the municipality.

The curbside program was quickly adopted by municipalities throughout Ontario. First launched in January 1987 by OMMRI and the MOE, the Blue Box program served over 400,000 single family households in the first year alone. By the end of 1989, approximately 1.8 million single family households were estimated to be participating in the Blue Box program, well exceeding the 50% recycling rate established by the Recycling Advisory Committee. When the program has been fully implemented, serving over 2.1 million households, the curbside recycling program will have penetrated 80% and 70% of Ontario's urban and rural single-family households respectively. Further explanation of the Blue Box system is provided in Section 3.4.1 - Residential Waste Recycled.

5.2.2 Physical Dimensions

Since 1981, with the introduction of a multi-material curbside pilot program in the City of Kitchener, the Blue Box program has grown at a phenomenal rate. Since the first

full-scale Blue Box program was launched in the City of Kitchener in 1983, the program's availability increased in 1987 to 41 communities (34 full-scale and 7 pilot programs). In 1989, 138 communities offered the services of a full-scale curbside recycling program. Table 5.1 shows the number of Blue Boxes distributed throughout Ontario. According to OMMRI data (1990), Ontario's multi-material recycling program has grown from 34% penetration of households in December 1988 to 60% penetration of household units (including apartment and rural areas) in June 1990, as shown in Figure 5.2.

Section 3.4.1 of this report - Residential Waste Recycled - provides a detailed description of the secondary data sources used and methodology applied to establish the quantities of material recycled in Ontario in 1987 and 1989. As illustrated in Table 5.2, the amount of traditional recycled materials (newspaper, glass, steel, aluminum, PET) collected in the residential sector has increased between 1987 and 1989. It is estimated that Ontario municipalities recovered 206,402 tonnes of recyclable materials in 1989 compared with 97,047 tonnes in 1987. The per Blue Box generation rate shown in this Table for 1987 and 1989 requires clarification. In 1987, while many municipalities were participating in residential recycling programs, the majority of the programs offered depot collection or curbside collection programs not classified as Class 1 (Blue Box) recycling programs. There were not very many Blue Boxes in circulation (399,000) hence per Blue Box generation rates appear artificially high, if all materials recycled are included. Consequently, calculating the amount of material recovered per Blue Box is exaggerated when depot materials are included in the calculation. The number of kg of material recovered per Blue Box in 1987 is similar to the figure calculated for 1989 if extraneous data are removed. It must be kept in mind that for each municipality the amount of materials collected through depot collection programs are combined with the Blue Box program results in the database. Table 5.3 presents the classes of recycling programs operating in Ontario in 1987.

5.2.3 Economic Dimensions

Since 1987, the Ministry of the Environment in conjunction with OMMRI have encouraged municipalities to implement residential curbside separation programs using a cost-sharing approach. In February 1990, the MOE and OMMRI II delegated \$38.7 million and \$45 million respectively over a five year period (refer to Table 5.4) with the aim to eventually offer curbside recycling to 80% and 70% of Ontario's urban and rural single-family households respectively, and to 20% of Ontario's apartments.

The most effective of these programs has been the MOE's Municipal Recycling Support Program (MRSP) and OMMRI's complementary funding initiative. Whereas the MRSP was developed to assist municipalities with the design, implementation and operation of recycling programs, OMMRI provides grants on a more limited basis.

Appendix C describes the various funding programs available for support of both residential and ICI waste recycling in Ontario at this time.

Table 5.1
ONTARIO SINGLE FAMILY DWELLINGS SERVED
BY THE BLUE BOX PROGRAM 1981-1989

County	Number of Blue Boxes								
	1981	1982	1983	1984	1985	1986	1987	1988	1989
Brant									29150
Bruce									3350
Kenora								3000	3000
Dufferin									8400
Durham							13000	85400	90000
Essex-Windsor							16500	83450	102600
Frontenac									25700
Grey								6400	15500
Halton			900	900	900	900	5900	62800	70100
Hamilton-Wentworth							14500	107660	109860
Huron									1900
Lambton									11100
Leeds-Grenville								6400	6400
Lennox and Addington									3700
Metro Toronto		3300	3300	3300	3300	3300	3300	199300	447300
Middlesex									6100
Muskoka/Haliburton							1200	10800	25340
Niagara					11500	30500	36000	115500	126100
Northumberland							7400	11600	12100
Ottawa-Carleton							101500	139700	154900
Oxford							2700	2750	10750
Peel						84500	99300	144800	153900
Perth							7500	7500	13450
Peterborough							18000	21500	21500
Renfrew									1300
Simcoe							7000	86200	86350
Stormont-Glengarry									700
Victoria									5150
Waterloo	300	300	35300	35300	35300	35300	37400	54700	79400
Wellington							27900	35350	37000
York								66950	129900
Total	300	3600	39500	39500	51000	154500	399100	1251760	1792000

Source: OMMRI

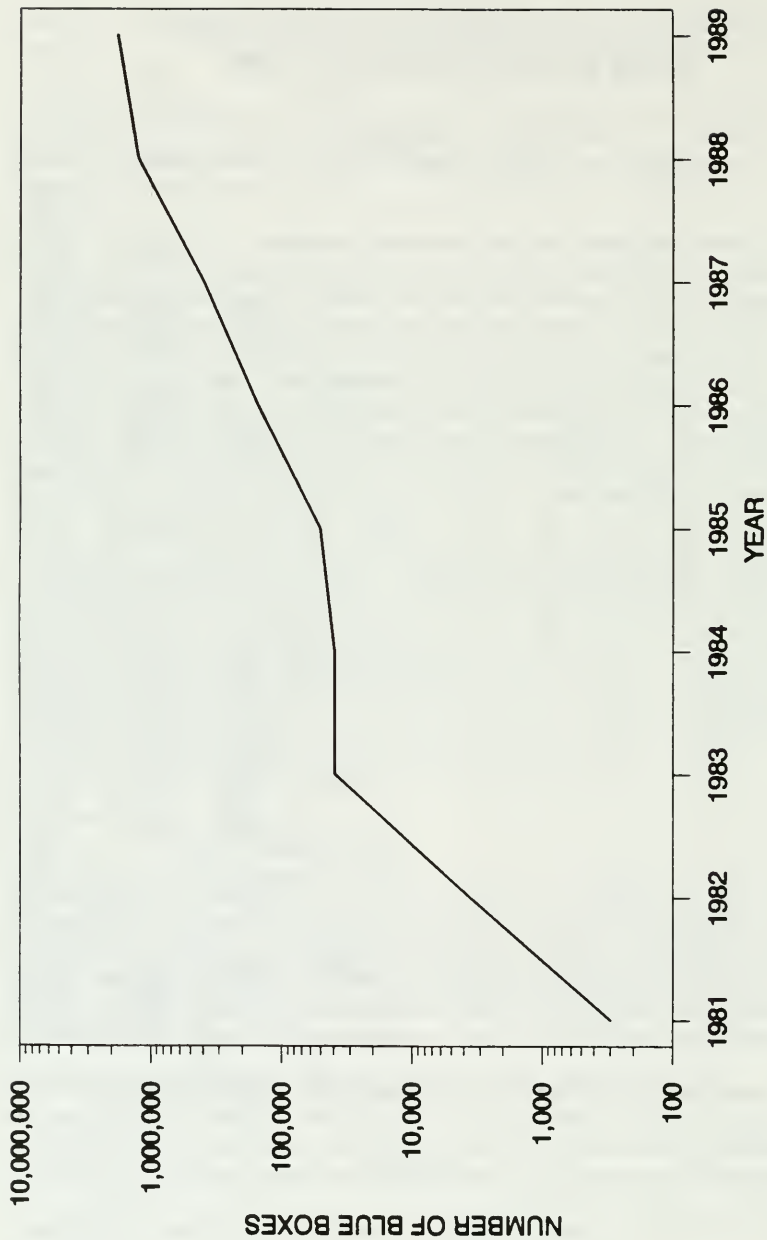


Figure 5.2
SINGLE FAMILY DWELLINGS SERVED BY BLUE BOX

Table 5.2
MATERIALS RECOVERED IN THE RESIDENTIAL SECTOR IN ONTARIO
IN 1987 AND 1989

	Newspaper	Glass	Steel	Aluminum	PET	Total
1987 (tonnes)	81913	11027	4071	---	36	97047
				Class 1 only		56051
Kg/Blue Box	205.2	27.6	10.2	---	0.09	243.2*
				Class 1 only		140.4**
1989 (tonnes)	155904	31360	17024	1613	502	206402
Kg/Blue Box	87	18	9.5	0.9	0.29	115.2***

* Total quantity generated in 1987 divided by 399,100 Blue Boxes

** Quantity generated by Class 1 programs in 1987 divided by 399,100 blue boxes.

*** Quantity generated by Class 1 programs in 1989 divided by 1,792,000 blue boxes.

Source: OMMRI and RIS

Table 5.3
THE STATUS OF RESIDENTIAL RECYCLING IN ONTARIO
1987 and 1989

County	Municipality	1987					1989
		Class 1	Class 2	Class 3	Class 4	Class 5	Class 1
Metro	Toronto	X			X		X
	Etobicoke			X		X	X
	Scarborough			X	X		X
	North York			X	X		X
	York			X	X		X
	East York						X
Durham	Oshawa			X	X		X
	Ajax	X					X
	Newcastle			X	X		X
	Pickering			X	X		X
	Whitby				X		X
	Brock						X
	Scugog						X
	Uxbridge						X
Halton	Burlington	X			X		X
	Halton Hills		X			X	X
	Milton	X			X		X
	Oakville		X		X		X
Hamilton/ Wentworth	Hamilton			X	X		X
	Stoney Creek	X					X
	Ancaster	X					X
	Dundas		X				X
	Flamborough						X
	Glanbrook						X
Niagara	Niagara Falls	X					X
	Port Colborne			X			X
	St Catharines	X					X
	Welland		X				X
	Thorold		X		X		X
	Fort Erie		X		X		X
	Grimsby	X			X		X
	Lincoln	X			X		X
	Niagara on the Lake						X
	Pelham	X			X		X
	Wainfleet						X
	West Lincoln	X			X		X

Table 5.3
THE STATUS OF RESIDENTIAL RECYCLING IN ONTARIO
1987 and 1989 (Cont'd)

County	Municipality	1987					1989
		Class 1	Class 2	Class 3	Class 4	Class 5	Class 1
Ottawa	Ottawa	X			X		X
	Kanata		X				X
	Nepean	X					X
	Gloucester	X					X
	Cumberland						X
	Osgoode						X
Peel	Brampton	X					X
	Mississauga	X			X		X
	Caledon	X				X	X
Waterloo	Cambridge	X					X
	Kitchener	X					X
	Waterloo						X
	Wilmut				X		X
York	Markham				X		X
	Newmarket			X		X	X
	Richmond Hill		X		X		X
	Vaughan				X		X
	Whitchurch-Stoffville				X		X
	East Gwillimbury						X
	Georgina						X
	King						X
Muskoka	Bracebridge	X			X		X
	Gravenhurst						X
	Huntsville						X
	Georgian Bay						X
	Muskoka Lakes			X		X	X
Brant	Brantford		X		X		X
	Paris						X
	South Dumfries						X
Bruce	Bruce Twp						X
	Mildmay						X
	Elderslie Twp						X
Dufferin	Orangeville						X
	Shelburne						X
	Mono Twp						X

Table 5.3
THE STATUS OF RESIDENTIAL RECYCLING IN ONTARIO
1987 and 1989 (Cont'd)

County	Municipality	1987					1989
		Class 1	Class 2	Class 3	Class 4	Class 5	Class 1
Essex	Windsor			X	X		X
	Amherstberg	X					X
	Essex	X					X
	Leamington	X					X
	Tecumseh	X			X		X
	Sandwich West	X					X
Frontenac	Kingston					X	X
	Kingston Twp						X
	Pittsburg						X
Grey	Owen Sound			X			X
	Durham						X
	Hanover						X
	Neustadt						X
	Egremont Twp						X
Huron	Howick						X
	Wingham						X
	Grey Twp						X
Kent	Ridgetown			X		X	X
Lambton	Sarnia			X		X	X
	Forest						X
Leeds & Gren	Brockville						X
Lennox & Add	Ernestown						X
Middlesex	London			X			X
	London Twp						X
	Lobo						X
	West Nissouri						X
	North Dorchester						X
Northumberland	Cambellford						X
	Cobourg	X			X		X
	Port Hope	X					X
	Brighton						X
	Colbourne						X
	Haldimand				X		X
	Hamilton Twp	X			X		X
	Hope Twp				X		X
Oxford	Woodstack		X				X
	Ingersoll						X
	E Zorra-Tavistock						X
	S W Oxford	X					X
	Zorra						X

Table 5.3
THE STATUS OF RESIDENTIAL RECYCLING IN ONTARIO
1987 and 1989 (Cont'd)

County	Municipality	1987					1989
		Class 1	Class 2	Class 3	Class 4	Class 5	Class 1
Perth	Stratford	X			X		X
	St Marys						X
	Mitchell						X
	Milverton		X		X		X
	North Easthope						X
	South Easthope						X
	Downie						X
	Hibbert						X
Peterborough	Peterborough		X		X		X
Renfrew	McNab						X
Simcoe	Barrie		X		X		X
	Alliston						X
	Collingwood						X
	Midland	X					X
	Penetanguishene	X					X
	Stayner				X		X
	Wasaga						X
	Adjala				X		X
	Creemore						X
	Tottnham				X		X
	Innisfil						X
	Orillia						X
	Essa						X
	Nottawasaga						X
	Oro						X
	Tay	X					X
	Tiny	X					X
	Elmvale						X
	Victoria	X					X
	Port McNicholl	X					X
Stormont-Glen	Winchester						X
Victoria	Lindsay						X
	Fenelon Falls					X	X

Table 5.3
THE STATUS OF RESIDENTIAL RECYCLING IN ONTARIO
1987 and 1989 (Cont'd)

County	Municipality	1987					1989
		Class 1	Class 2	Class 3	Class 4	Class 5	Class 1
Wellington	Guelph	X			X		X
	Fergus	X					X
	Mount Forest					X	X
	Elora	X					X
	Erin	X			X		X
	Eramosa						X
	Erin Twp	X					X
	Maryborough						X
	Nichol	X					X
	Peel Twp				X		X
	Puslinch				X		X
	West Garafraxa				X		X
Kenora	Dryden						X

Source: OMMRI

Note: Refer to Section 3.4.1 for a description of Classes.

Table 5.4
FUNDING AVAILABLE FOR RECYCLING PROGRAMS IN 1990

Ministry of the Environment - Annual Funding	
\$25.1 million	• Municipal curbside programs. • Apartment and depot programs.
\$8.2 million	• Industrial waste reduction, reuse and recycling programs.
\$4.0 million	• Community and home-based composting projects.
\$2.0 million	• Research and development of end-use and markets.
Ontario Multi-Material Recycling Incorporated (OMMRI)	
\$45.0 million	• To support various recycling activities over a five year period.
Source: Hanson, May 1990.	

Data Availability

To better understand the costs associated with municipal recycling programs, investigations were conducted to identify secondary sources of economic data. Extensive research led to the discovery of two reliable sources of information about the capital and operating expenditures associated with municipal recycling programs. These were:

- Ministry of the Environment, Municipal Recycling Support Program

Since the Municipal Recycling Support Program's commencement, the Ministry of the Environment has required program operators to submit grant applications for Ministry review and approval. Financial information consists of capital and operating expenditures associated with the implementation of the curbside recycling program. A description of the MRSP is contained in Appendix C.

- Ministry of Treasury and Economics, Public Accounts of Ontario

A further source of information on financial expenditures associated with recycling programs is the COBIS report. The government of Ontario publishes annual reports detailing the monies spent by each ministry for the year-end fiscal period. Although the expenditure information is disaggregated according to the program recipient, the level of detail fell short of this project's requirements.

Data from the MRSP were used to estimate the financial component of recycling for inclusion into the study database. The MRSP data provided to the study team provides grant approval information over a three year period (1987, 1988 and 1989). Although the total financial expenditures associated with recycling exceed those costs reported in the MRSP grant applications, municipalities fund the majority of the recycling costs through capital and operating budgets.

Through conversations with supervisors of the MRSP program, it also became apparent that not all municipalities submitted grant applications for payment even though they may have introduced a curbside recycling program. Despite this limitation, in most cases, those municipalities reported by OMMRI to have a curbside separation program also applied for funding through the MRSP grant program.

Data Manipulation

Due to the different cost-sharing structure of the capital and operating grants of various funding programs in effect in Ontario described in Appendix C, the actual costs incurred were estimated by two methods, using available data. These are described below:

- **Operating Costs** - The MOE funds the operating costs using a declining cost-sharing schedule. The first year of the grant applications the recycling program operator receives 50% funding and for each subsequent year the funding decreases by 10%, from 40% to 30% to 20% to 10% in the final year of the five year program. This funding schedule was applied for each program operating in Ontario beginning with the year 1987. If the program commenced after 1987 (in 1988 or 1989) then the first year of the funding schedule would begin in that year.
- **Capital Costs** - The MOE funds one-third of the capital costs for each year the grant is approved. This simple funding schedule was applied for every program regardless of the year involved.

In some instances the curbside recycling program is contracted to a private company or a non-profit organization. The grants approved for these programs usually represent the costs incurred by the company to service a group of municipalities. To accommodate the aggregated nature of the private/nonprofit sector operated programs, a separate coded number was issued to each program in the study database. However, the same data manipulation principals were applied to the capital and operating costs reported in the MRSP.

Results

It appears from the available data that the amount of monies expended by municipalities on recycling programs increased between 1987 and 1989. In 1987 it was estimated that approximately \$10 million was spent on a variety of recycling programs ranging from depot to curbside recycling. By 1988, the estimated expenditures increased to \$30 million as more municipalities implemented the Blue Box recycling program. It is estimated that the expenditures in 1989 equalled approximately \$42.5 million. Table 5.5 summarizes the operating and capital expenditures for Ontario's municipalities to implement and maintain municipal recycling programs.

In addition, financial statements for the other funding programs were provided where available. Included in the 1989 provincial total is the funding from the Municipal Reduction/Reuse Program, as recorded in the 1988-1989 COBIS (Public Expenditure) Report (see Table 5.6).

Comparing the costs to collect one tonne of recycled materials in 1987 and 1989 shows that the overall costs appear to have risen. Based on an estimated total cost of \$9,975,768 (capital and operating) to collect an estimated 97,000 tonnes of material in 1987, municipalities incurred an average expense of \$102.79 per tonne to collect and process materials for recycling. **A breakdown of the proportion of 1987 capital to operating costs was not available.** Based on an estimated operating cost of \$25,764,792 in 1989 and an estimated 206,403 tonnes of material collected, the operating cost for collection and processing recycled materials from residential sources averaged \$124.83/tonne. This excludes the estimated \$16,803,380 expended on capital equipment. The increased operating cost per tonne is likely related to the fact that more materials are now being handled by recycling programs, causing an increase in required sorting time.

These numbers represent gross costs and do not take into account the monies received through the sale of the materials to the recycling markets. Table 5.7 presents the prices paid by the recycling markets for newspaper, glass, steel and PET in 1988, 1989 and 1990. The table illustrates that the prices paid have declined over the past several years, and while the price received for glass has remained constant, municipalities have met with more stringent sorting specifications resulting in higher capital/retrofit equipment costs.

Table 5.5
ESTIMATED EXPENDITURE ON RECYCLING PROGRAMS IN ONTARIO
1987 TO 1989

County	Municipality	1987	1988		1989	
		Cost (\$)	Operating (\$)	Capital (\$)	Operating (\$)	Capital (\$)
Metro		366,500	70,438	0	0	0
	Toronto	NAP	161,600	884,400	0	0
	Etobicoke	NAP	344,000	0	1,408,250	124,017
	Scarborough	NAP	0	0	1,040,850	3,405,666
	North York	19,500	519,375	1,679,700	0	0
	York	NAP	198,400	0	NAP	NAP
	East York	NAP	48,080	553,542	60,100	553,542
Durham		766,000	1,203,500	238,590	2,145,132	1,148,400
Halton		936,000	10,400	0	149,622	1,584
Hamilton/ Wentworth	Hamilton	325,350	0	0	0	0
	Stoney Creek	NAP	11,600	17,160	0	0
	Ancaster	5,500	NAP	NAP	0	12,157
	Dundas	NAP	2,300	38,280	0	2,838
	Flamborough	23,866	0	4,620	0	0
	Glanbrook	NAP	9,960	43,989	0	0
Niagara	Niagara Falls	NAP	0	17,526	0	0
	Port Colborne	NAP	38,440	151,322	0	0
	St Catharines	333,000	0	104,511	475,938	30,525
	Welland	55,200	0	14,995	0	0
	Thorold	23,500	0	16,190	0	0
	Fort Erie	NAP	66,200	226,380	0	0
	Grimsby	NAP	0	3,350	0	2,640
	Lincoln	NAP	0	3,350	0	0
	Niagara on the La	19,100	0	6,353	0	0
	Pelham	NAP	0	3,350	0	0
	Wainfleet	NAP	NAP	NAP	29,280	22,011
	West Lincoln	NAP	0	2,679	0	0
Ottawa	Ottawa	820,000	1,926,225	0	2,665,773	0
	Kanata	NAP	0	11,022	87,560	145,316
	Cumberland	NAP	110,160	276,887	152,800	0
Peel	Brampton	628,000	920,475	146,520	517,044	6,369
	Mississauga	1,109,500	1,241,935	0	1,704,863	109,725
	Caledon	30,800	116,625	169,884	109,032	164,439
Waterloo		NAP	0	0	295,620	4,298,613
	Cambridge	27,200	485,058	0	587,400	16,500
	Waterloo	146,332	175,875	0	317,823	132,957
	Wilmot	NAP	0	0	8,000	0

Table 5.5
ESTIMATED EXPENDITURE ON RECYCLING PROGRAMS IN ONTARIO
1987 TO 1989 (Cont'd)

County	Municipality	1987	1988		1989	
		Cost (\$)	Operating (\$)	Capital (\$)	Operating (\$)	Capital (\$)
York		NAP	50,000	0	562,375	320,760
	Markham	NAP	361,400	1,056,000	919,500	6,600
	Newmarket	NAP	0	0	200,340	416,625
	Richmond Hill	376,600	0	329,109	440,720	167,442
	Vaughan	NAP	19,000	0	0	0
	Whitchurch-Stouff	NAP	45,420	140,168	0	0
	East Gwillimbury	NAP	43,240	131,241	0	0
	Georgina	NAP	10,000	0	235,125	357,291
Muskoka	Bracebridge	67,100	28,875	0	0	0
Brant	Paris	NAP	NAP	NAP	60,620	27,984
Bruce	Bruce Twp	NAP	0	0	35,620	16,038
	Mildmay	NAP	0	0	15,340	13,101
	Elderslie	NAP	0	0	9,346	3,373
Dufferin	Orangeville	NAP	15,000	0	163,450	36,795
Essex		991,240	1,397,946	2,214,663	2,472,250	523,512
Frontenac	Kingston	NAP	0	2,034,450	364,000	226,050
Grey	Owen sound	NAP	36,020	141,471	107,300	171,435
	Hanover	NAP	NAP	NAP	18,020	21,186
	Neustadt	NAP	3,230	1,584	6,238	33
	Egremont					
Huron	Howick	NAP	0	0	25,140	22,275
	Wingham	NAP	6,120	9,620	30,663	0
	Grey Twp	NAP	17,300	9,801	0	0
Lambton	Sarnia	NAP	10,000	0	0	0
	Forest					
Leeds-Gren	Brockville	NAP	71,120	576,609	25,828	165,264
Middlesex	London	NAP	0	0	535,000	0
	N Dorchester	NAP	NAP	NAP	70,380	164,109
Oxford	Woodstock	6,000	0	0	0	0
	E Zorra-Tavistock	NAP	17,860	15,576	85,875	0
	S W Oxford	56,000	51,325	29,700	67,947	14,289
	Zorra	NAP	13,040	21,450	81,000	0
Perth	Stratford	156,860	100,025	115,104	89,496	89,364
	St Mary's	NAP	0	0	33,980	12,870
	Mitchell	NAP	NAP	NAP	16,100	9,240
	N Easthope	NAP	MAI	NAP	13,835	4,818
	S Easthope	NAP	NAP	NAP	13,835	4,818
	Downie	NAP	NAP	NAP	34,080	7,392
	Hibbert	NAP	0	0	7,020	9,983
Peterborough	Peterborough	NAP	NAP	1,744,809	0	0
Reafrew	McNab	NAP	0	0	19,960	44,979

Table 5.5
ESTIMATED EXPENDITURE ON RECYCLING PROGRAMS IN ONTARIO
1987 TO 1989 (Cont'd)

County	Municipality	1987	1988		1989	
		Cost (\$)	Operating (\$)	Capital (\$)	Operating (\$)	Capital (\$)
Simcoe	Barrie	59,800	NAP	NAP	0	0
	Innisfil	NAP	70,400	69,630	138,750	5,280
	Orillia	10,000	18,700	152,262	133,225	0
	Oro	NAP	0	0	48,800	50,160
	Elmvale		9,060	4,620	10,825	7,557
Stormont-Glen	Winchester	4,300	550	6,435	0	0
Victoria	Lindsay	NAP	0	126,489	104,560	473,220
Wellington	Guelph	492,250	657,000	122,100	992,970	27,258
Kenora	Dryden	NAP	0	0	1,500	672,098
Lambton (Bluewater Recycling Association)	Forest Alvinston Arkona Grand Bend Thedford Watford Bosanquet Twp	NAP	NAP	NAP	226,800	459,360
Haldimand-Nor Muskoka (Muskoka Recycling Association)	Bracebridge Gravenhurst Huntsville Muskoka Lakes	26,000 NAP	32,765 126,000	0 518,100	0 421,950	733,920 43,098
Niagara (Niagara Recycling)	Niagara Falls Port Colborne Welland Thorold Grimsby Lincoln Niagara-Lake Pelham Wainfleet West Lincoln	448,000	722,610	1,049,928	888,327	409,233
Simcoe (North Simcoe Waste Mgmt Association)	Midland Penetanguishene Port McNicholl Victoria Harbour Tay Tiny	228,000	301,375	243,012	628,465	621,720

Table 5.5
ESTIMATED EXPENDITURE ON RECYCLING PROGRAMS IN ONTARIO
1987 TO 1989 (Cont'd)

County	Municipality	1987	1988		1989	
		Cost (\$)	Operating (\$)	Capital (\$)	Operating (\$)	Capital (\$)
Peterborough (Scotts Plains Recycling)	Peterborough	592,470	493,750	2,640	572,748	13,596
Simcoe (South Simcoe Waste Mgmt)	Alliston Adjala Bradford Beeton Cookstown Tecumseth Tosorontio	14,400	125,325	293,370	490,809	122,430
Hamilton/ Wentworth (Third Sector)	Hamilton Stoney Creek Ancaster Dundas Flamborough	711,400	1,518,998	166,650	2,070,614	0
Wellington (Wellington Recycling Group)	Fergus Harriston Mount Forest Palmerston Arthur Clifford Drayton Elora Erin Arthur Twp Eramosa Erin Guelph Maryborough Minton Nocholl Peel Twp Pilkington Puslinch West Garafraxa West Luther	100,000	195,500	14,698	401,795	129,525
COBIS - MRRP Program		117,184				
Subtotal		9,975,768	14,159,162	15,955,889	25,764,792	16,803,380
Total		9,975,768	30,115,051		42,568,172	

Table 5.6
MINISTRY OF THE ENVIRONMENT
PUBLIC EXPENDITURES REPORTED IN THE COBIS REPORT

Program	Grants From The MRSP			Reduction/Reuse
	1986-1987	1987-1988	1988-1989	1988-1989
Corporations				
Durham Recycling Centre Inc.	\$160,245			
Essex Region Conservation Authority	\$301,569		\$635,676	
Grey Bruce Waste Recycling	\$65,000	\$76,000		
Niagara Employment Agency	\$184,000	\$218,526	\$260,949	
North Simcoe Waste Management Assoc.	\$132,000	\$121,353	\$118,800	
Scott's Plains Recycling Inc.	\$43,004	\$196,626	\$181,481	
Muskoka Recycling Association			\$56,865	
South Simcoe Waste Management Assoc.			\$45,117	
Third Sector Recycling		\$276,000	\$411,076	
Wellington Recycling Group			\$60,007	
West Northumberland Recycling Group	\$49,000	\$70,480	\$109,499	
Regions				
Durham	\$326,000	\$189,000	\$488,360	
Halton	\$1,079,231	\$197,403	\$43,006	
Metropolitan Toronto			\$30,000	
Cities				
Brampton	\$196,327	\$314,000	\$360,208	
Brockville			\$33,154	
Cambridge		\$104,305	\$161,537	
Guelph	\$36,134	\$164,977	\$219,370	
Mississauga	\$449,167	\$535,452	\$414,432	
Ottawa		\$282,317	\$305,851	
St. Catharines			\$127,500	
Stratford		\$37,055	\$33,382	
Waterloo			\$63,820	
Towns				
Fort Erie			\$30,030	
Markham			\$163,930	
Richmond Hill			\$76,554	
Townships				
Innisfil			\$35,138	
Cumberland			\$51,048	
Georgian Bay			\$62,500	
Total	\$3,021,677	\$2,783,494	\$4,579,290	\$58,592

Source: COBIS

Table 5.7
RECYCLING MARKET PRICES PAID: 1988 TO 1990

Product	1988 (\$/tonne)*	1989 (\$/tonne)*	1990 (\$/tonne)*
Newspaper	\$40-45	\$45 - first 20-30% \$9-15 - remaining	\$7-12**
Glass	\$60 sorted \$40 mixed	\$60 sorted \$35 mixed	\$60 sorted \$0-15 mixed
Steel	\$75	\$70	\$70 loose \$90 densified
Aluminum		\$1200 baled	\$1400-2000 baled
PET	\$400 baled \$200 unbaled	\$400 baled \$200 unbaled	\$300 baled \$125 unbaled

* Prices shown are in current dollars and do not take inflation into account.

**Price determined by export markets due to labour dispute at Ontario de-inking mill.

Source:

- OMMRI, February, 1990.
- Personal communications with RCO, September/October 1990.

Table 5.8 summarizes available cost data, along with estimated revenues from the sale of collected materials.

It is interesting to note that despite the additional support provided by the Ministry of Northern Development and Mines' (MNDM) Municipal Recycling Support Program, by the end of 1989 only one northern community, Dryden of Kenora District, had taken advantage of the grant.

5.2.4 Future Trends

Riding on the successes of the Blue Box program, the Ministry of the Environment and OMMRI have taken the opportunity to expand the program to encompass a larger portion of the population. Funding has been set aside to help multi-unit buildings, schools, commercial businesses and industries to divert their solid wastes from landfill to recycling programs. A special grant has also been introduced to further supplement the costs incurred by northern communities during the initiation of a recycling program.

Municipalities are also being encouraged to expand the Blue Box program beyond the traditional four materials (newspaper, glass, metal and PET) to include other recyclable materials. Some municipalities have expanded their program to incorporate mixed plastic materials. The first program to collect mixed plastics began in Guelph in March 1989 and since then has been adopted by the larger Regions of Metropolitan Toronto, Peel, York, Halton and Niagara. Other communities have also included corrugated cardboard, phone books and household hazardous waste as part of their recycling programs.

A number of potential recyclable waste materials have graduated beyond the conceptual stage to the pilot project stage. Currently, a handful of municipalities have begun pilot projects to test the feasibility of recycling film plastic, boxboard, magazines and fine paper. These initiatives are summarized in Table 5.9.

One material in particular that has received a great deal of attention over the past year is that of organic waste. To date, many municipalities have tackled the problem of recycling kitchen and yard waste by offering, free-of-charge or on a cost-share basis, individual composters to households. As of June 1989, seventeen municipalities were promoting home composting activities.

Recently, a few municipalities have begun experimenting with a compost collection and centralized processing scheme in which kitchen and/or yard wastes are captured through the curbside recycling program and processed at large, specially engineered composting facilities. Demonstration participants include the City of Guelph, the City of Mississauga and Metropolitan Toronto. In one case, Guelph's wet/dry system is unique in that it is the first program in North America that endeavours to collect organic kitchen waste at the curbside. Residents are requested to separate their wastes according to a two stream collection system (two containers for wet wastes and dry

Table 5.8
ESTIMATED COSTS AND REVENUES OF RECYCLING PROGRAMS IN ONTARIO
(1987 AND 1989)

Material	1987				1989			
	Quantity Collected (tonnes)	Price *(a)	Revenue (\$)	Cost	Quantity Collected (tonnes)	Price *(b)	Revenue (\$)	Cost
News	81,913	\$42.50	\$3,481,302		155,904	\$20.25	\$3,157,056	
Glass	11,027	\$50.00	\$551,350		31,360	\$47.15	\$1,478,624	
Steel	4,071	\$75.00	\$305,325		17,024	\$70.00	\$1,191,680	
Aluminum	-	-	-		1,613	\$1,200.00	\$1,935,600	
PET	36	\$300.00	\$10,800		502	\$300.00	\$159,600	
Total Quantity	97,047				206,403			
Total Revenue			\$4,348,777				\$7,913,560	
Total Cost				\$10,000,000 (c)				\$42,500,000 (d)
Net Cost				\$5,651,223				\$34,586,440

*Average of price ranges in Table 5.7.

- a) 1988 market prices used.
- b) Assume 25% at \$45, 75% at \$12.
- c) Capital and operating costs combined, no breakdown available
- d) \$16,803,380 capital cost.
\$25,764,792 operating cost.

Table 5.9
STATUS OF INNOVATIVE RECYCLING PROGRAMS IN 1989

County	Material				
	Mixed Plastics	Composting	Old Corrugated Cardboard	Magazines	Telephone Books
Brant	Brantford-mixed				
Bruce		Port Elgin			
Kenora					
Dufferin					
Durham	yes	yes	depot		
Essex					
Frontenac					
Grey	yes				
Halton			yes	pilot	
Hamilton					
Huron					
Lambton	Sarnia-HDPE				
Leeds-Grenville					
Lennox & Addington					
Metro Toronto	yes	yes	yes		yes
Middlesex					
Muskoka/Haliburton					
Niagara		Fort Erie			
Northumberland					
Ottawa-Carleton		Kanata, Ottawa			yes
Oxford					
Peel	Mississauga-mixed	yes	depot		Mississauga
Perth					
Peterborough					
Renfrew					
Simcoe		Orillia, S. Simcoe			
Stormont-Glenarry					
Victoria					
Waterloo	Cambridge-LDPE	yes			
Wellington	Guelph-mixed	Guelph	Guelph		Guelph
York			Richmond Hill		

Sources: OMMRI, 1990
RIS, 1990
SWISC, 1990
MacLaren Engineers, Inc. in-house files

wastes) or a three stream collection system (three containers for organics, recyclable materials and non-recycled garbage). Initial results show the need to reduce confusion over the complexity of the program by designating easy to use and readily identifiable containers.

In Ontario, as elsewhere in North America, recycling markets have been supply driven and although municipalities have been guaranteed markets for their recyclable materials (assuming they meet end user standards), the prices continue to decline, as illustrated in Table 5.7. Despite the abundant supply of recyclable materials recovered through municipal recycling programs, the recycling market has been slow to respond to the changing market forces. This situation has played havoc with municipal recycling programs and the materials being diverted through the Blue Box program, for example:

- **Newspapers** - Newspapers are presently being stockpiled in warehouses or sold for export for extremely low prices as a result of a strike at Quebec and Ontario Paper Company's de-inking mill. Since this is the only fully operating de-inking mill in Ontario, municipalities have little opportunity to switch to other de-inking mills while the strike is in progress. Market forces do not work in the municipalities' favour under this monopsonistic (single buyer) situation. Up to now, municipalities had to rely on one company to set fair prices and to guarantee acceptance of all recovered newspapers. This situation will change in the near future. Four new de-inking facilities are being planned which can accept newsprint from the Ontario market. These are:
 - Atlantic Packaging, Whitby
 - Canadian Pacific Products
 - Thunder Bay
 - Gatineau, Quebec
 - Diashowa, Quebec City (1992)

Abitibi Price are also considering construction of de-inking plants (Reference: Colin Johnston, Quebec and Ontario Paper Company).

- **Glass** - The glass recycling market also operates in a monopsonistic (single buyer) setting in which competitive forces do not come into play. The onus has been placed on municipalities to meet glass sorting specifications as occurred in January, 1990 when Consumers Glass introduced a new pricing schedule to encourage municipalities to source separate. In order to receive the higher purchasing price for sorted glass, municipalities have had to retrofit existing collection vehicles or purchase new ones which permit separation of glass at the source. Under present market circumstances, little incentive exists to improve the processing system at the recycling plant. Municipalities are also facing the problem

associated with material contamination. Recent increases in volumes of materials recovered from municipal curbside and depot recycling programs have been accompanied by increased levels of contamination in the glass supply, reflected in lower purchasing prices.

The recycling market has been slow to meet the growing supply of recycled materials by increasing the number of end users. Slowly, though, this situation is changing. New end users of the recycled materials have begun to penetrate the market causing the recycling market to shift from its characteristic supply driven state to a demand driven one. For example, the Atlantic Packaging de-inking mill is now operational in Whitby. Other examples are cited in Section 3.4.2. In addition, some local governments have taken on the responsibility of encouraging market activity by passing bylaws that promote product stewardship. The City of Toronto recently passed a bylaw, effective July 1991, that prohibits the sales of newspapers not containing a minimum 50% recycled content through vending machines. It is hoped that the current short-term state of market underdevelopment will be resolved over the long-term as recycling becomes an essential component of society's waste management activities.

A more comprehensive discussion of 3R's markets is provided in *RIS Market Assessment of 3R's Activities in Ontario, 1991*.

5.3 MATERIAL RECOVERY FACILITIES

5.3.1 General Description

Over the past decade, residential and industrial/commercial institutional (ICI) recycling activities have become integral components of Ontario's waste management system. Responding to the flow of materials diverted from landfills, communities have had to construct material recovery facilities (MRFs).

"A MRF is an intermediate processing centre where collected, mixed, recycled solid waste materials are separated into marketable, industrial 'feedstocks' for use in the manufacture of new products. MRFs can process glass, metals, plastics, and mixed grades of paper" (Combs, 1990). In order to change wastes into marketable material, MRFs perform several activities. The number and degree to which these tasks are performed, and the types of materials which are processed vary from facility to facility, but generally include:

- sorting/separation, and
- processing, including shredding, baling, crushing and granulation.

For each process, there are specific types of equipment which must be used. The types of equipment can be classified into three main categories:

- sorters
- balers/densifiers, and
- shredders/granulators

Sorting can be done manually or with sorting machines. There are mechanical sorters available for materials such as plastic pop bottles and ferrous and non-ferrous metals. However, separating of coloured glass, and magazines from newspapers and other papers is still performed manually in most cases.

In the case of many mixed plastics, and various grades of paper, shredders and granulators are used, to make the material more attractive to end-users. Similarly, glass is often crushed at the facility before distribution to end users, as well. This process allows more material to be transported in one container; and therefore, reduces haulage rates for the end-user of the materials. After breaking down the materials, some of them are baled, as in the case of newspapers, plastic bottles and metal cans. Once materials have undergone these various processes, they are distributed to end users.

A MRF designed to provide these services for municipal and commercial waste materials targeted for recovery will generally include receiving areas for incoming materials segregated by type, areas for processing equipment, upgrading and quality control, and shipping and post-processing storage until time of shipment. Adjacent to the warehouse portion of the building are offices and staff facilities (please refer to Figure 5.3).

Presently, MRFs process a variety of recycled materials originating from the residential sector. Traditional "Blue Box" recycling materials include newspapers, glass, tin, aluminum and PET containers. Some municipalities may also process corrugated cardboard and other plastics.

Depending on the design of the ICI recycling program, materials such as fine paper and corrugated cardboard may be collected and processed by end-user companies or sent to the MRF for processing and distribution.

5.3.2 Physical Dimensions

Presently in Ontario, there exist 31 MRFs, most of which are located in South Central Ontario. Facilities may be operated by one of three agents - the municipality, private sector or third sector. Third sector groups are those companies that are characterized as non-profit interest organizations. In general, most MRFs are owned and operated by private companies such as Laidlaw Waste Systems Ltd. and McLellan Waste Disposal. These two companies alone own and operate eight MRFs, servicing the

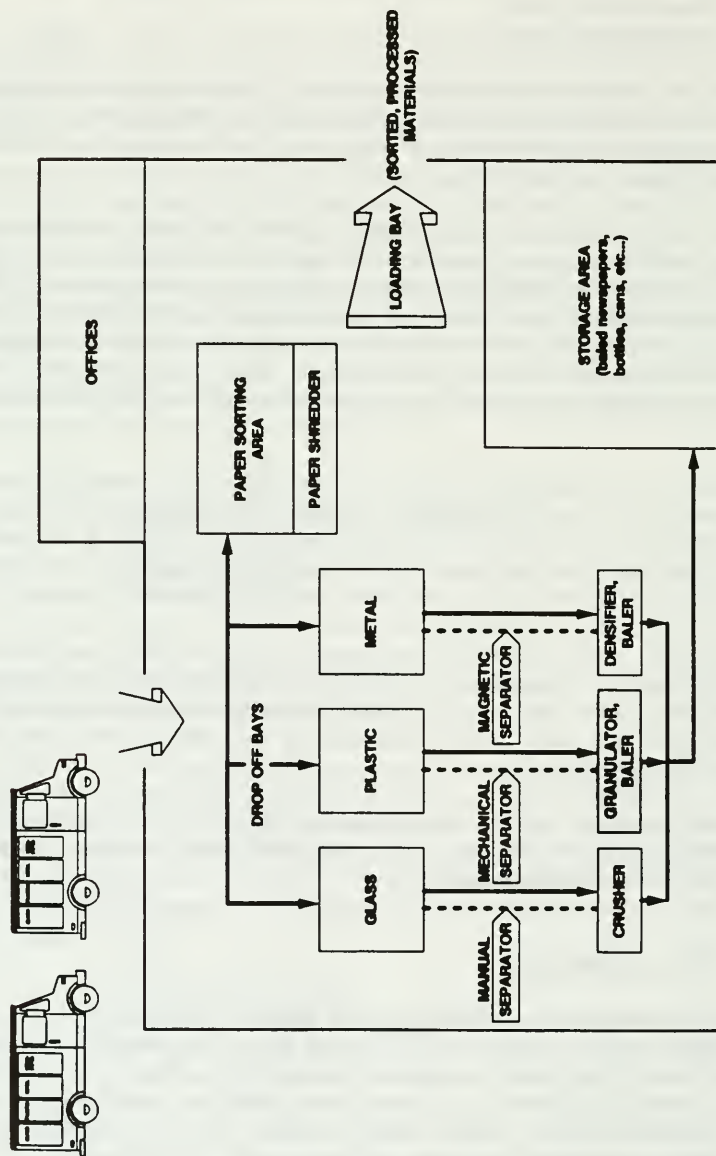


Figure 5.3
SIMPLIFIED MRF SCHEMATIC

Cities of Barrie, Guelph, Kingston, Kitchener, Mississauga, Mount Forest and Ottawa. Of the remaining 23 facilities, 12 are operated by smaller private companies, seven are operated by third sector groups and four are operated by the municipality. Figure 5.4 presents a pie chart of these figures.

Larger municipalities tend to have a facility built within their boundaries and permit surrounding communities to use their facility. This arrangement exists in the Cities of Guelph, Windsor, Mount Forest and Stratford. In remote areas that lack a large central community, municipalities may pool their resources and develop a recycling program servicing a large area. Included in this category are the following programs: Muskoka Recycling Association, North Simcoe Waste Management Association, Northumberland Recycling and Bluewater Recycling Association.

Of the 31 operating MRFs surveyed recently by VHB, 14 respondents indicated that they employed a total of 308 full time and 17 part time staff. Nine of these facilities started their operations after 1987.

Although the types of material handled by MRFs differs, the 14 facilities surveyed are fairly consistent in their acceptance of typical Blue Box materials, as would be expected. Non-traditional items such as organic wastes, tires and wood are handled by a far smaller portion of the MRFs surveyed. Table 5.10 presents a complete listing of the materials handled by the facilities surveyed.

5.3.3 Economic Dimensions

As with recycling programs, little detailed information on costs has been compiled for MRFs. This is in part due to the speed at which they have started up in Ontario and in part due to the sensitive nature of this information to the private sector.

Generic capital and operating costs were obtained for a MRF, having a capacity of 6,600 tonnes year, from a report prepared by CH2M Hill of Boston for Brattleboro, Vermont, April 1990 (See Table 5.11). Equipment prices were increased 20% to reflect the exchange rate from U.S dollars to Canadian currency. Employee salaries were upgraded to reflect current market rates.

Table 5.11 shows that estimated capital costs (excluding land values) are \$127/tonne/year capacity. Operating costs are estimated at \$54/tonne.

5.3.4 Future Trends

As waste management evolves, some municipalities are considering comprehensive waste handling systems in which all facilities associated with waste management are housed in a common area. As an example, the Region of Waterloo has pursued this system design and is presently constructing a material recovery facility adjacent to a

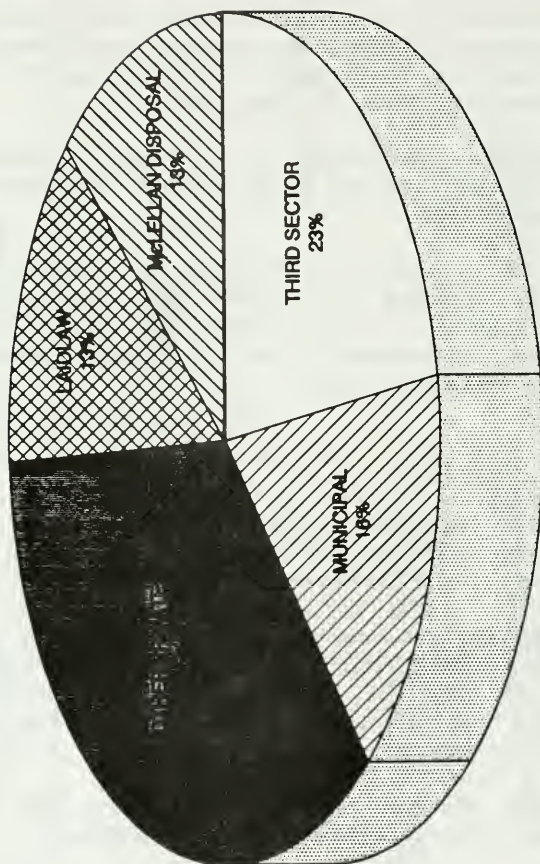


Figure 5.4
PRIVATE, MUNICIPAL & THIRD SECTOR OWNERSHIP
OF MATERIAL RECYCLING FACILITIES (IN PERCENT)

Table 5.10
WASTE TYPES HANDLED AT MATERIAL RECOVERY FACILITIES

Components Handled By Material Recovery Facilities (MRF's)	Number of MRF's Accepting	Percentage of Survey Response
Composite Packaging	5	36%
Old Corrugated Cardboard (OCC)	8	57%
Construction/Demolition Wastes	2	12%
Glass (Food and Beverage Containers)	14	100%
Household Hazardous Wastes	2	14%
Aluminum (Foil)	3	21%
Aluminum (Food and Beverage Containers)	13	93%
Steel (Food and Beverage Containers)	14	100%
Mixed Paper and Magazines	5	36%
Telephone Books	5	36%
Newsprint	13	93%
Fine Paper	9	64%
Boxboard	3	21%
Plastics (Rigid)	7	50%
Plastics (Film)	6	43%
Diapers	1	7%
Yard Wastes	2	14%
Wood Wastes	3	21%
Used Tires	1	7%
White Goods	2	14%
Food Wastes	1	7%
Other	1	7%
Source: VHB Survey, 1990		

Table 5.11
GENERIC COST FOR 6,600 TONNE PER YEAR
MATERIAL RECYCLING FACILITY

Capital Cost	Variable
Site and Building	
Land Aquisition	\$0
Site Preparation	\$30,000
Building, 25m x 30m, 4.5m Eave Height (750 sq. m)	\$500,000
Metal Sides and Roof on Concrete Subfloor	
with complete mechanical and electrical systems	
Subtotal - Site and Building	\$530,000
Processing Equipment	
Balers(2)(Paper,Plastic,Cans)	\$22,000
Chopper/Baler (Newspaper)	\$10,000
Crusher (Glass)	\$17,000
Conveyors, 5 m x 1 m (2)	\$36,000
Magnetic Separator	\$13,000
Forklift, Front-end Loader, with attachments	\$35,000
Chipper (Yard Wastes)	\$22,000
Contingency	\$54,000
Recycling Vehicles (1)	\$100,000
Subtotal - Processing Equipment	\$309,000
Total Capital Cost	\$839,000
Operation and Maintainance	
Labour (includes 25% fringe benefits)	
Conveyor line operators (3)	\$75,000
Equipment operators (2)	\$70,000
Administrative assisstant (1)	\$28,000
Supervisor	\$45,000
Subtotal - Labour	\$218,000
Overhead	
Maintainance	\$50,000
Electricity	\$25,000
Fuel, etc.	\$25,000
Administration	\$15,000
Insurance	\$25,000
Subtotal - Overhead	\$140,000
Total Operating Cost	\$358,000

Source: CH2M HILL INC. and ENVIROLOGIC INC., 1990.

household hazardous waste facility, a centralized composting facility and an ICI material drop-off area. This approach promotes more effective and efficient administration.

MRF operations and recycling collection programs are expanding as new technology and markets are developed to process and recycle an increasing range of materials. New programs have already been initiated in some areas, for example, magazine recycling in Halton and mixed plastics recycling in Mississauga. Consideration is also being given to special facilities designed to process "non-traditional" materials such as wood, tires and construction wastes. The Peel Region wood recycling facility is an example of these developments. "As markets are developed, and legislation passes for landfill bans, MRFs of tomorrow will recover and process an increasing variety of residential, commercial, demolition and household hazardous wastes", (Waste Age, 1990).

An active future is predicted for material recovery facilities. New markets are being discovered and existing ones expanded as recycling becomes a more acceptable and indeed, integral part of Ontario's waste management infrastructure. MRFs will play an increasingly important role as processors and distributors in the system as municipalities and businesses work towards the waste diversion targets set out by the MOE.

5.4 PRIVATE AND THIRD SECTOR RECYCLING AGENTS

5.4.1 General Description of Industry

The recycling industry in Ontario is comprised of both private businesses and interest groups which may be non-profit and/or staffed by volunteers. The latter of these two enterprises has been referred to as the third sector of the recycling industry. This subsection describes in general terms how recyclers operate and where they fit into the flow of economic goods and services.

Unfortunately, businesses involved in recycling activities do not fit clearly into the traditional breakdown of standard industrial classifications. However, information has been collected from a number of sources in an attempt to generate a clearer picture of their economic interactions. Definitions of the various players in the recycling sector have been developed by Recoup's Canadian Recyclers Directory, and these are paraphrased below:

- | | | |
|-------------------|---|--|
| Generators | - | Any source of any type of recyclable materials. |
| Collectors | - | Small, often one-man, part-time operations, which collect small quantities of recyclable materials from local sources for sale to dealers. |

Dealers	-	Operations who accumulate recyclable materials, sometimes from collectors, sort them manually and mechanically, and offer them for sale to brokers and processors.
Brokers	-	Agents for processors/consumers of recyclable materials, who, for a fee, guarantee to obtain the quantity of materials required and delivery of the same. Usually associated directly with processors.
Processors	-	Companies which convert recyclable materials to meet the specifications of consumers. Large equipment such as shredders, balers and presses may be used.
Consumers	-	Those companies which may use both virgin and recycled materials as feed. Examples include pulp and paper mills, glass manufacturing and steel mills. Another term often used is end users.

Depending upon the material being considered, any or all of the above players may be involved, and the same company may fill a number of roles. In this study, the generic term used to describe collectors, dealers, brokers and processors, whether they operate municipal programs or in the private sector, is *recycling agents*.

5.4.2 Physical Dimensions

Three principal sources of information were used to develop data on the size of the recycling industry in Ontario, as described in Section 2.7. The first was information from Dun and Bradstreet, the second was a RCO study of municipal recycling programs and the third was Recoup's Canadian Recyclers Directory.

The major source of data on recycling agents was Dun & Bradstreet, who provided information on two SIC groups which cover recycling agents. The first SIC was 4953 (Refuse Systems) which covers establishments engaged in recycling of waste materials and also covers haulers as noted in Section 4.5. The second was SIC 5093 (Wholesale of Scrap and Waste Materials) which includes establishments engaged in automotive wrecking for scrap, bag reclaiming, scavenging and wholesales of the following wastes:

- waste bottles, boxes, oil, textiles and rags
- iron and steel, nonferrous metals and rubber scrap
- general line of junk and scrap.

From these descriptions, it appears that all types of agents including collectors, dealers, brokers and processors would be included in these two groups.

As discussed in Section 4.5, a telephone survey of companies listed in SIC 4953 was conducted by Dun & Bradstreet (D & B). Of 295 companies listed with D & B, 65 participated in the survey. Information on these 65 firms will be discussed first, followed by information on the remaining 230, which was limited to D & B's existing database.

Thirty four of the surveyed firms identified themselves as involved in the processing of recycled materials. The vast majority, 25 (74%), are also involved in hauling or other activities as summarized in Figure 4.8 of the previous chapter.

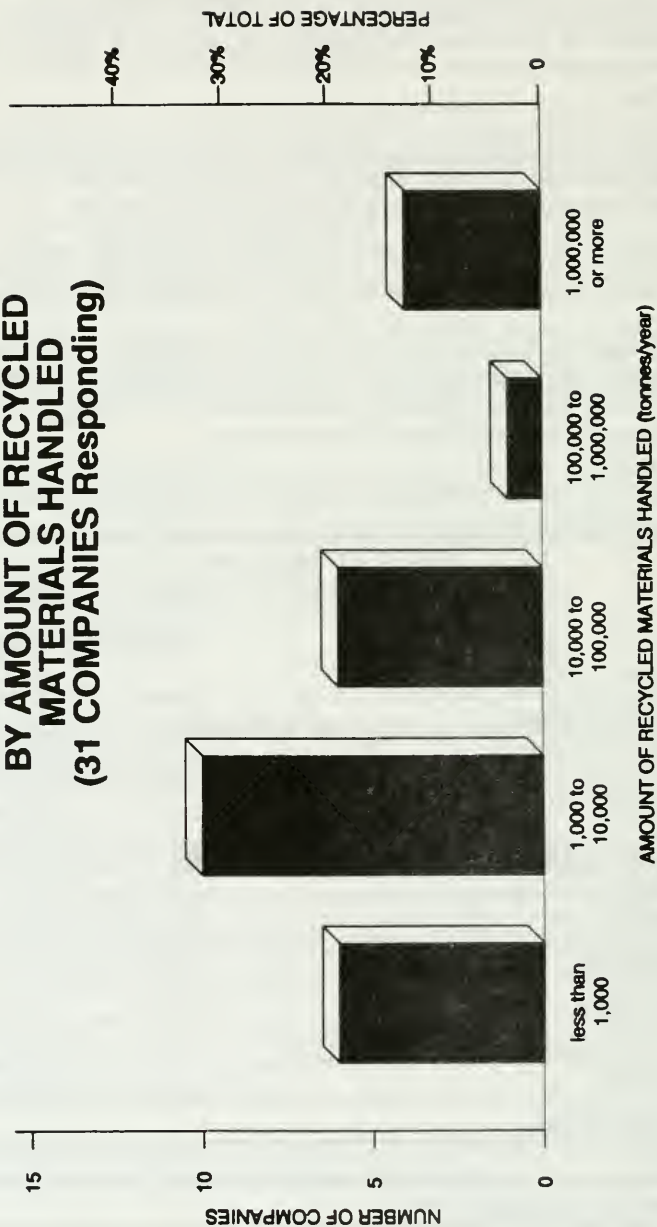
Thirty three (33) firms reported employment totalling 486. Figure 5.5 presents the distribution of companies based on amount of recyclable materials handled.

The sources of recycled materials were also identified. Distribution of reported composition by source (commercial, industrial or residential) is summarized in Figures 5.6 to 5.8. From these figures, it is evident that the companies in this survey handle predominately commercial and industrial wastes.

Table 5.12 summarizes materials processed by the reporting companies.

Table 5.12 MATERIALS PROCESSED BY AGENTS SURVEYED	
Recycled Material	Number of Companies Reporting Processing
Aluminum	13
Corrugated Cardboard	8
Drywall	3
Fine/Office Paper	8
Glass	5
Newspaper	5
Plastic	10
Rubber Tires	4
Tinplate Steel	6
Wood Waste	4
Liquid Waste	6
Miscellaneous Metal	2
Other	2
Source: Dun and Bradstreet, 1990	

Figure 5.5
DISTRIBUTION OF COMPANIES
BY AMOUNT OF RECYCLED
MATERIALS HANDLED
(31 COMPANIES Responding)



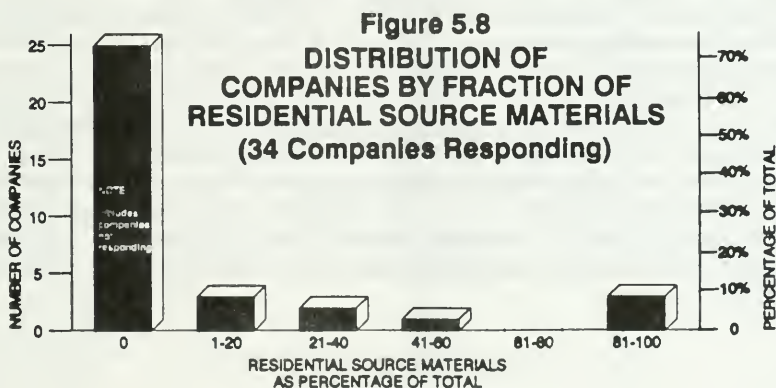
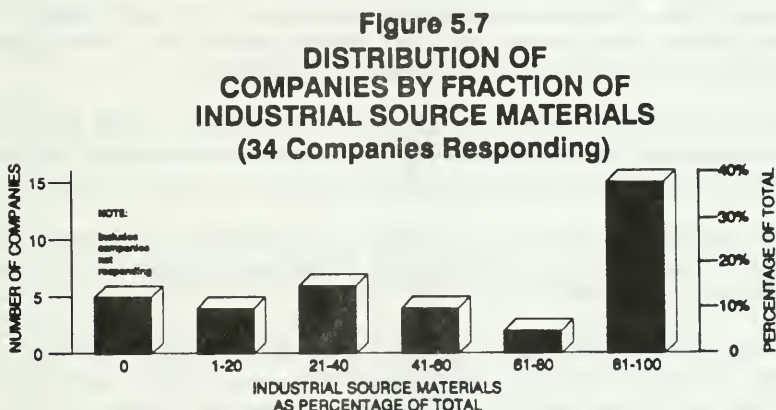
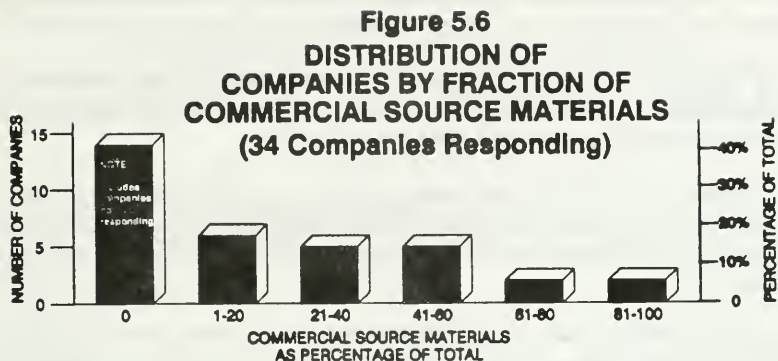


Table 5.13 summarizes the municipalities served by the reporting companies. Information on equipment use was also solicited, and is summarized in Table 5.14.

The only information on physical dimensions for the remaining 230 companies in SIC 4953 is employment. Twenty-four firms (96%) of 25 firms who list waste recycling as their primary activity reported employment totalling 570.

The information in SIC 5093 (Wholesale of Scrap and Waste Materials) covers 285 companies. All 285 companies report 5093 as their primary SIC classification. It is interesting to note that only five of the companies report SIC 4953 (Refuse Systems) as a secondary SIC.

Two hundred and eighty-two companies (99%) reported employment figures, totalling 2,830 for the Ontario branch offices reporting. Figure 5.9 presents a bar chart of the distribution of the number of employees. 220 firms (77%) have fewer than 10 employees. Two hundred and seventy two companies (95%) also reported a total employee figure, which includes employees outside Ontario and in other subsidiaries not in SIC 5093. The total of these figures is 3,389 employees.

Table 5.15 summarizes the year of start-up for the 285 firms. While the number of firms started in the 1980's is almost as high as the number of those which have survived since before 1970, the younger firms tend to be smaller as noted in Table 5.15.

The data on this SIC is stored in the database SIC5093.DBF. It is made up of the standard information kept on file by Dun & Bradstreet, referred to as the "Canadian DMI System Tape Record".

The second source of information is the recycling agent database which was compiled from the 1987 RCO study of municipal recycling programs and was supplemented with up-to-date information from the MOE Waste Management Branch and the VHB/MacLaren survey of materials recovery facilities. In 1987, 88 municipalities were served by 98 active recycling programs. A total of 80 recycling agents, both active and inactive, were identified from all information sources. Thirty, or 37.5%, were private sector agents and twenty four, or 30%, were from the third sector. The remaining twenty six, or 32.5%, were municipal agents. Examples of recycling agents are Laidlaw Waste Systems, a private agent; the Whitchurch-Stouffville Recycling Group, a third sector agent and the Region of Peel, a municipal agent. There were 52 active recycling agents in 1987 employing 287 full- or part-time staff, 10 of whom were physically or mentally challenged, and 207 volunteer workers. Other information on the amounts of materials handled and the municipalities served by these programs is summarized in Section 3.4.

Table 5.13
MUNICIPALITIES SERVED BY AGENTS SURVEYED

Municipality	Number of Agents Reporting Service
Ajax	7
Barrie	4
Belleville	2
Brampton	5
Brantford	4
Burlington	4
Caledon	2
Cambridge	5
Chatham	7
Cornwall	2
East York	4
Etobicoke	5
Guelph	1
Halton Hills	3
Hamilton	3
Kingston	1
Kitchener	2
London	1
Markham	1
Milton	2
Mississauga	3
Newcastle	2
Newmarket	2
Niagara Falls	2
North York	3
Oakville	2

Table 5.13
MUNICIPALITIES SERVED BY AGENTS SURVEYED

Municipality	Number of Agents Reporting Service
Oshawa	3
Ottawa	3
Peterborough	1
Pickering	3
Richmond Hill	1
Sault Ste. Marie	1
Scarborough	1
St. Catharines	1
Toronto	6
Windsor	6
Whitby	2
York	1
Other	2

Source: Dun & Bradstreet, 1990

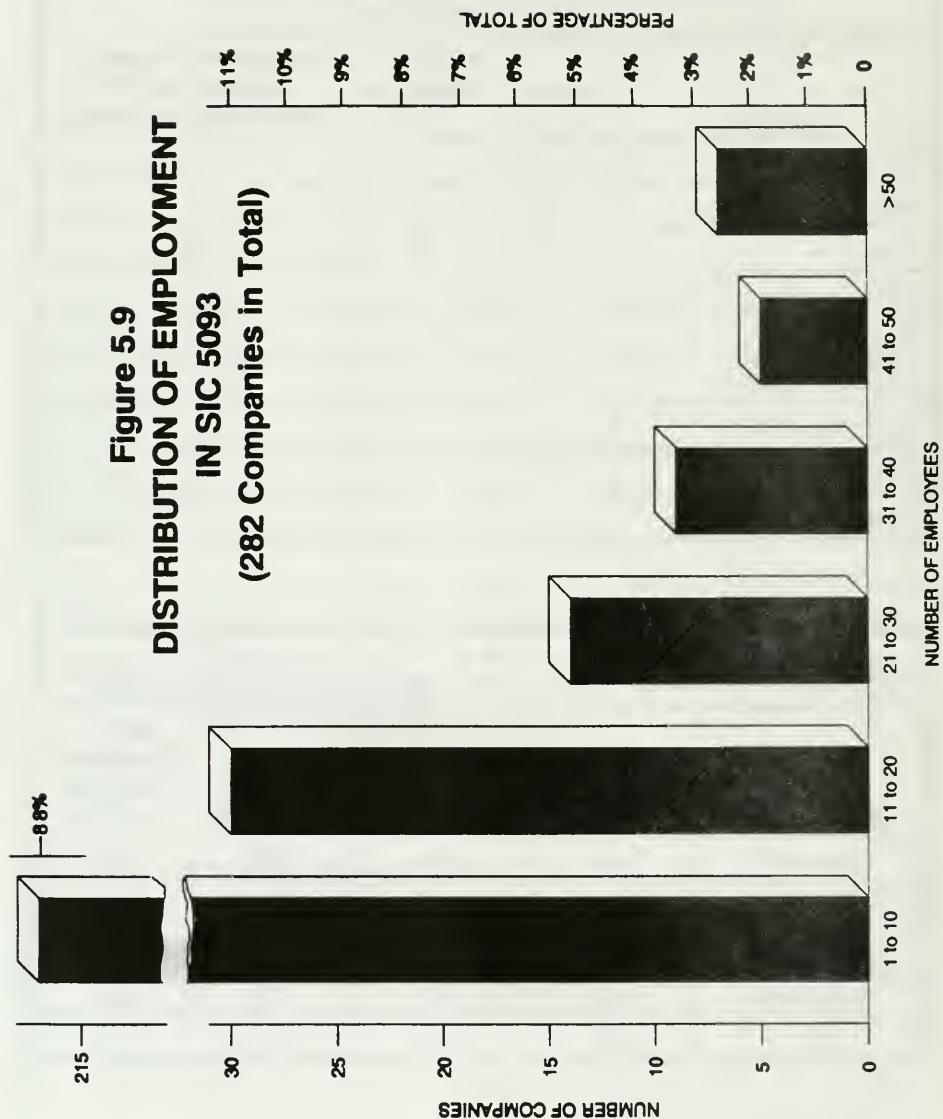
Table 5.14
SUMMARY OF RECYCLING EQUIPMENT IN USE
BY AGENTS SURVEYED

Equipment	Number in Use	Number of Companies Using	Number of Companies Using Equipment Manufactured in Ontario
Air Classifiers	10	6	3
Balers	141	15	9
Conveyors	206	15	13
Glass Crushers	0	0	0
Paper Shredders	12	8	4
Magnetic Separators	46	11	7
Metal Densifiers	8	4	1
Metal Flatteners	4	3	2
Plastic Granulators	11	4	2

Table 5.15
SUMMARY OF EMPLOYMENT IN SIC 5093 FIRMS BY START-UP YEAR

Start-up Year	Number of Firms	Percentage of Firms	Total Employees	Average Number of Employees per Firm
pre-1970	108	37.9	1275	11.8
1970-1979	76	26.7	761	10.0
1980-1989	89	31.2	665	7.5
Not reported	12	4.2	129	10.8
All	285	100.0	2,830	9.9

Figure 5.9
DISTRIBUTION OF EMPLOYMENT
IN SIC 5093
(282 Companies in Total)



Finally, the database compiled from the 1987 Recoup's Canadian Recyclers Directory lists 295 agents. Most of these are described by their function as well as materials handled. This information is summarized in Tables 5.16 and 5.17. Unfortunately, not all of the records include such information.

5.4.3 Economic Dimensions

The Dun & Bradstreet information has been the major source of economic data on recycling agents.

Once again, results for the 65 companies participating in the telephone survey are discussed first. Twenty of 34 companies identified as agents reported annual sales figures totalling \$16,648,000. Figure 5.10 presents a distribution of companies by percentage of business in Ontario. Figure 5.11 illustrates percentage of business recycling represents.

Some limited information on prices charged by recycling agents to sources of recyclable materials was also available from the survey results and is summarized in Table 5.18. Note that it was not possible to distinguish between no response and a response of \$0/tonne. In general, it should be assumed that \$0/tonne means that a response was not provided.

Figure 5.12 summarizes operating costs.

The only economic data on the remaining 230 companies in SIC 4953 are annual sales figures. For these 25 firms listing "Recycling Waste" as their primary activity, 10 firms (40%) reported sales figures totalling \$32,980,000.

In SIC 5093, 141 companies (49%) reported annual sales figures totalling \$558,455,500.

5.4.4 Future Trends

One important barometer of future trends for recycling agents is the opinion of those in the business. The survey conducted for this study by Dun & Bradstreet asked two questions soliciting the opinion of recycling agents on their future business. It is important to note that responses to questions of this nature tend to be somewhat optimistic, but do reflect the climate of business.

Thirty six recycling agents responded to Question 4 of the survey which read:

In the future, as more waste reduction, reuse of materials, and recycling programs are implemented, how do you see the growth of your business? Do you think your business will have:

Table 5.16
SUMMARY OF RECYCLING FUNCTIONS FROM RECOUP'S CANADIAN
RECYCLERS DIRECTORY

Recycling Function	Number of Agents	Percentage of Agents
Dealer	33	11.1%
Broker	32	10.8%
Processor	21	7.1%
Consumer	4	1.3%

Table 5.17
SUMMARY OF MATERIALS HANDLED FROM RECOUP'S CANADIAN
RECYCLERS DIRECTORY

Material	Number of Agents	Percentage of Agents
Paper	63	21.3%
Glass	19	6.4%
Plastic	66	22.3%
Metal	158	53.5%

- 1) Substantial growth
- 2) Slight growth
- 3) Stay the same
- 4) Slight loss of business
- 5) Substantial loss of business

Figure 5.13 uses a pie chart to summarize the percentage breakdown of responses. No company reported that they anticipated a substantial loss of business and slightly more than half anticipated substantial growth.

The same number of agents responded to Question 5, which read:

In the future, as more waste reduction, reuse of materials, and recycling programs are implemented, how do you see your company's costs changing? Do you think your business costs will have:

Figure 5.10
DISTRIBUTION OF COMPANIES
BY FRACTION OF BUSINESS
IN ONTARIO
(36 Companies Responding)

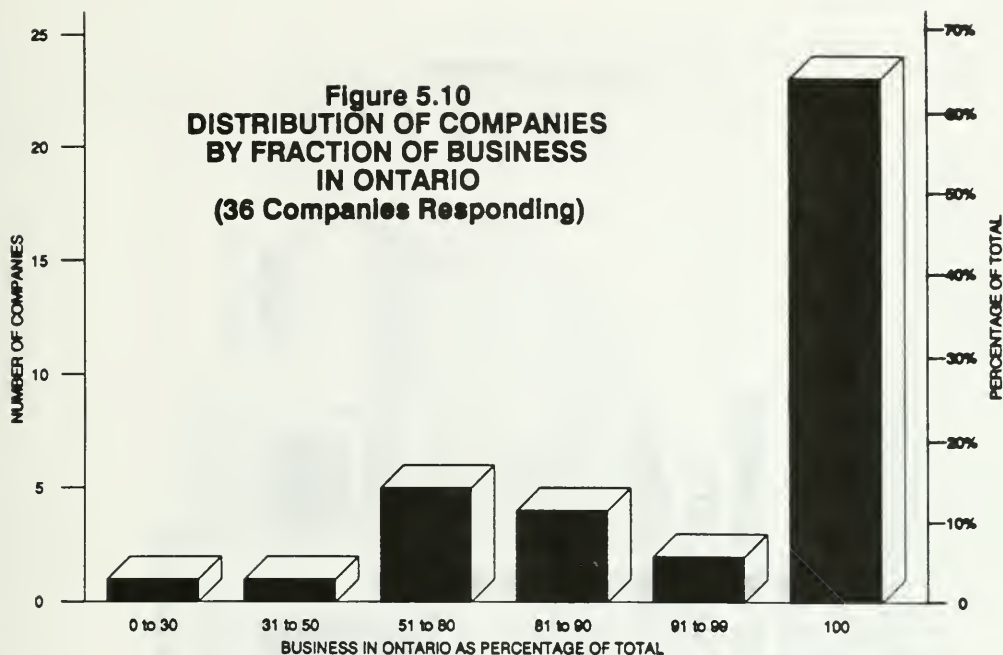


Figure 5.11
DISTRIBUTION OF COMPANIES
BY FRACTION OF BUSINESS
RECYCLING REPRESENTS
(32 Companies Responding)

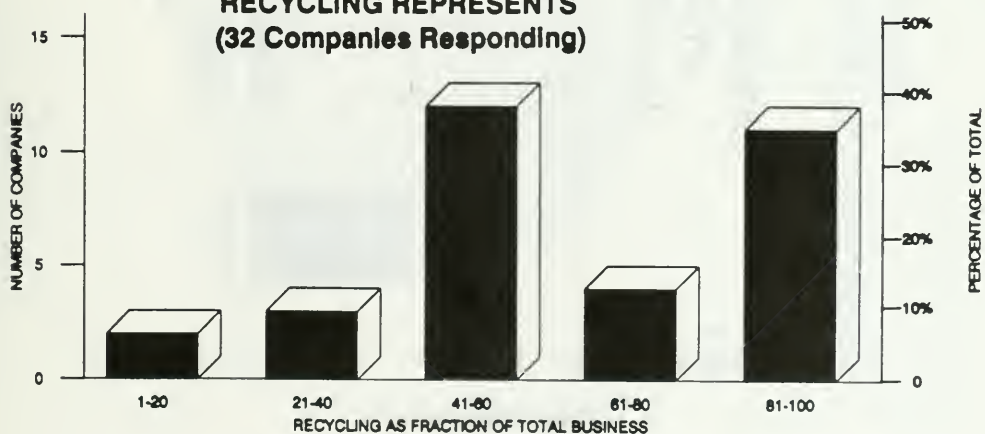
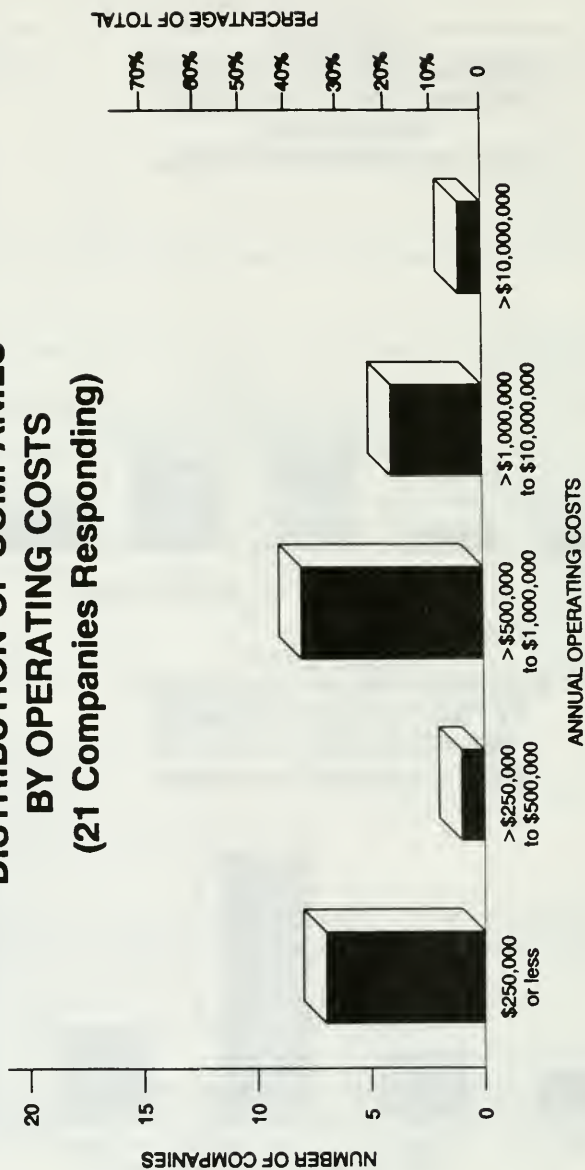


Figure 5.12
DISTRIBUTION OF COMPANIES
BY OPERATING COSTS
(21 Companies Responding)



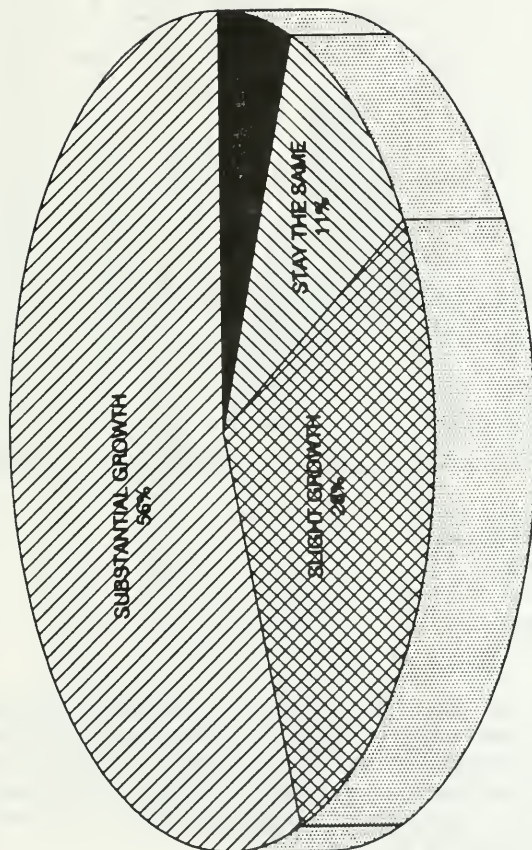


Figure 5.13
SUMMARY OF OPINIONS ON FUTURE CHANGES IN SIZE
OF RECYCLING BUSINESSES

Table 5.18
SUMMARY OF PRICE INFORMATION FROM AGENTS SURVEYED

Material	Number of Companies Reporting Price >\$0/tonne	Reported Range in Price (\$/tonne)	Mean Reported Price (\$/tonne)
Aluminum	4	28 - 360	158
Corrugated Cardboard	5	28 - 217	94
Drywall	2	110 - 217	164
Fine/Office Paper	5	25 - 110	55
Glass	2	-	28
Newspaper	3	28 - 83	46
Plastic	4	28 - 550	258
Rubber Tires	1	-	110
Tinplate Steel	2	28 - 110	69
Wood Waste	1	-	30
Liquid Waste	1	-	400
Miscellaneous Metals	1	-	4
Other	2	55 - 217	136

- 1) Substantial increase
- 2) Slight increase
- 3) No change
- 4) Slight decrease
- 5) Substantial decrease

Figure 5.14 again uses a pie chart to summarize the percentage breakdown of responses. It would appear that business is well aware of the impacts of new regulatory initiatives on their costs. Approximately one-quarter expect a substantial increase in costs, while an additional one-third anticipate slight increases. By the same token, however, it would appear that opinions regarding growth indicate that the industry believes that increases in costs can be overcome.

The responses to these two questions indicate a generally positive attitude toward opportunities for growth in the private sector recycling business. Appropriate policy initiatives will serve to foster and promote these attitudes, and enhance business activities.

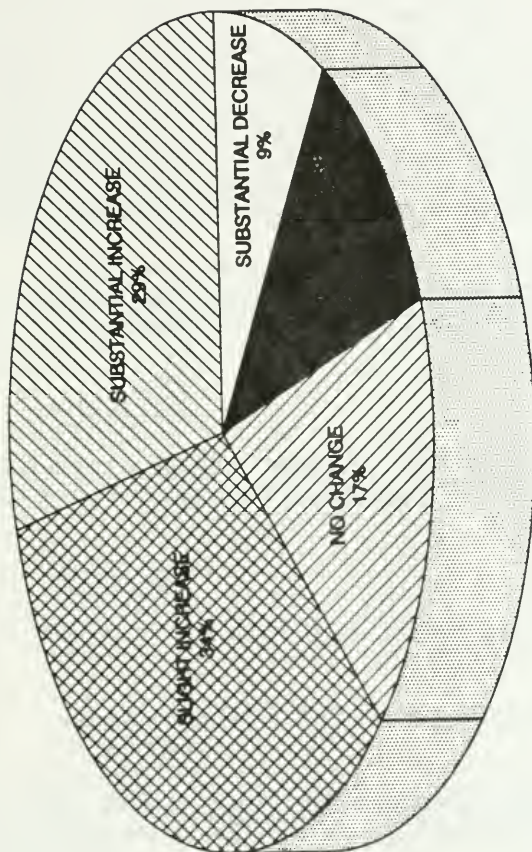


Figure 5.14
SUMMARY OF OPINIONS ON CHANGES IN THE COSTS OF
THE RECYCLING BUSINESS

Section 6

EXECUTIVE SUMMARY

6.1 BACKGROUND

In January 1990, the MOE Policy and Planning Branch awarded a contract to CH2M HILL ENGINEERING LTD. (with MacLaren Engineers as subcontractors) to develop a database on the Physical and Economic Dimensions of the Municipal Solid Waste Management System in Ontario. The study was carried out concurrently with three other studies to assess the socio-economic impacts of the waste diversion objectives announced on March 10, 1989. The objectives stated that 25% of the waste stream was to be diverted from landfill and incineration by 1992, and 50% was to be diverted by the year 2000. A base year 1987 (adjusted for population growth) has been used for all of these objectives. The three other studies carried out concurrently, and the consultants awarded the contracts for these studies are as follows:

- Market Assessment of 3Rs Activities in Ontario (RIS & VHB)
- True Costs of Waste Management (VHB & MacLaren)
- Co-ordination and Synthesis (VHB & Econometric Research Ltd.)

6.2 OBJECTIVE

The basic objective of this study (referred to as the MSW study) was to provide a working snapshot of the current waste management system in Ontario.

6.3 METHOD

The waste management system was divided into two major components for the study, namely:

- waste generation (i.e. quantities of waste produced by various sectors)
- waste disposal

As much information as possible was obtained on waste generation for different counties and municipalities in Ontario through a review of all available Waste Management Master Plans.

Residential waste composition was estimated by combining information from a number of sources, including the recently completed study by Gore and Storrie. Industrial/commercial/institutional waste composition and generation rate information was obtained from a number of waste audits carried out in the province. This information was divided into 25 ICI categories. The composition and quantities of ICI waste produced

by each county in Ontario was estimated using employment data for the county. The estimates were corrected using actual data, where available. This exercise resulted in an estimate of the quantity and type of each waste produced in the province.

Information on landfills in the province was obtained from Waste Management Master Plans, the MOE Site Summary Reports, the MOE Inventory of Open and Operating Landfills, and a survey of 420 landfills carried out by MacLarens/VHB as part of a concurrent study.

Information on the three MSW incinerators in operation in Ontario was obtained through telephone conversations with the operators. Information on transfer stations was obtained in Waste Management Master Plans, and was confirmed by follow-up phone calls.

Information on haulers was obtained through an industry survey carried out by Dun and Bradstreet as part of this study. Information on the hauling and recycling industries was purchased from Dun and Bradstreet.

Information on recycling programs, expenditure on recycling, and the quantities of material recycled was obtained from the MOE Waste Management Branch, OMMRI and the COBIS Report. Information on Material Recycling Facilities (MRFs) was obtained through a survey carried out by MacLarens/VHB during a concurrent study.

6.4 **SCOPE**

The scope of the study was limited to municipal solid waste (MSW), i.e. non-hazardous material which is currently disposed at municipal landfills and incinerators. It also included material which is currently collected from the residential sector and recycled.

6.5 **SUMMARY OF FINDINGS**

6.5.1 **Waste Generation**

1. The Ontario Residential Sector generated an estimated 3,901,900 tonnes of waste in 1987, and an estimated 4,053,200 tonnes in 1989. This equates to a generation rate of approximately 420 kg/capita/year for both years.
2. The major components of residential waste are paper (36%), organics (32%), glass (7%), plastic (6%) and tinplate steel (6%).
3. Of these general categories, specific categories, which contribute significantly to the waste stream are newsprint (16.7%), food waste (15.5%) and yard waste (16.2%).

4. An estimated 2.5% of the residential waste stream was recycled in 1987. This increased to 5.1% in 1989.
5. An estimated 5,189,000 tonnes of waste was generated by the industrial/commercial/institutional (ICI) sector in 1987, and an estimated 5,361,000 tonnes was generated in 1989. This equates to an average generation rate of 560 kg/capita/year in 1987, and 559 kg/capita/year in 1989.
6. The major waste types generated by the ICI sector include: OCC, wood, paper, organics and metal.
7. The major generators of MSW in the ICI sector include the construction industry (an estimated 1.6 million tonnes in 1989), the communications and service sector (an estimated 1.3 million tonnes in 1989), wholesale and retail trade (an estimated 550,000 tonnes in 1989), transportation industries (an estimated 380,000 tonnes in 1989) and the food and beverage industry (an estimated 340,000 tonnes in 1989).
8. Complete data are not available on the percentage of MSW recycled by the ICI sector. Information obtained by RIS in a concurrent study indicate that a minimum 279,760 tonnes of waste was recycled by the ICI sector in 1989. This equates to 5.2% of the ICI waste stream.
9. Traditionally, comprehensive records of waste disposal at landfills and incinerators have not been maintained, hence reliable waste generation information is not available for many locations in the province.
10. In the past, very little information was collected on the composition of MSW. This has changed in the last year or two, with the landfill crisis in Southern Ontario, and the need to divert more materials from landfill. Many Ontario municipalities are now embarking on waste audit and waste composition studies to better define the components of the waste stream.

6.5.2 Waste Disposal

1. Landfilling is the method of disposal for most of Ontario's MSW. Less than 2% of Ontario's MSW is incinerated. An estimated 1% of Ontario's MSW was recycled through residential recycling programs in 1987. This figure increased to 2% in 1989. At least a further 3% of the total waste stream is recycled by the Ontario ICI sector. This figure may be higher but data are not available to substantiate this assumption at this time.
2. Ontario has over 1,400 landfills. Of these, 630 (45%) serve communities with populations less than 1,500, and another 350 (25%) are operated by Ministry of Natural Resources.

3. An estimated 40% of Ontario's annual landfill capacity will be lost in the next 1 - 3 years. Approximately 17% of Ontario's landfill capacity will be lost in 1991 with the projected closure of two of the province's largest landfills, Britannia Road (750,000 tonnes/year) and Brock West (964,000 tonnes/year). An additional 23% of Ontario's landfill capacity will be lost in 1993, with the projected closure of the Province's largest landfill, Keele Valley (2,250,000 tonnes/year).
4. Of the province's remaining landfills, an additional 95 are expected to reach capacity in 1991-1993. An estimated 145 will reach capacity between 1994 and 2003, and 10 will extend beyond the year 2004.
5. Landfill tipping fees vary through the province, from zero at some landfills to \$150/tonne in the Metro Toronto area. In some cases, tipping fees have increased dramatically in the last few years. Metro Toronto area tipping fees have increased as follows: \$18 (1987), \$50 (1988), \$85 (1989), \$97 (1990), and \$150 (1991). Increased tipping fees have encouraged 3Rs, which can now be justified on an economic basis.
6. Some smaller communities are reluctant to raise tipping fees, because of a concern about illegal dumping of waste.
7. Ontario has three incinerators which accept MSW. These are: SWARU Hamilton, and 3M and Victoria Hospital in London. Their combined capacity is 177,000 tonnes per year.
8. Sixty five hauling companies were surveyed as part of this study, and reported employment of 792. An additional 145 haulage companies who were not surveyed employ an estimated 1,977. However, some of these firms may be involved in other activities in addition to hauling. Total reported sales for haulers (both surveyed, and not surveyed) were \$102,856,000. If it is assumed that large companies generally report sales figures, then this value should capture most of the haulage industry. The majority of respondents to the study survey anticipate a favourable business climate in the future.

6.5.3 Waste Recycling

1. Residential waste recycling programs have increase dramatically in the last few years. In 1987, 400,000 households were served by the Blue Box Program. This number had increased to 1.8 million households by 1989.
2. An estimated 97,000 tonnes of waste generated by the residential sector was recycled in 1987, and an estimated 206,400 tonnes was recycled in 1989. This translates to recycling rates of 2.5% and 5.1% of the residential waste stream for 1987 and 1989 respectively.

3. An estimated \$10 million was expended by municipalities on residential waste recycling in 1987. This increased to an estimated \$30 million 1988 and \$42.5 million in 1989.
4. Because the available 1987 data were not broken down into capital and operating costs, direct comparison of 1987 and 1989 costs is not possible. However, the data show an estimated operating cost of \$124.83 per tonne of residential waste recycled in 1989.
5. The prices paid for recycled material have varied over the last three years, and with the exception of aluminum have generally decreased. The reported 1990 prices were \$7 - 12/tonne for newspaper. This price was low because of a labour dispute at the only Ontario de-inking mill. Prices for other recycled materials were \$60/tonne for sorted glass, \$70/tonne for loose steel, \$90/tonne for densified steel, \$1,400 - 2,000/tonne for baled aluminum, \$300/tonne for baled PET, and \$125/tonne for unbaled PET.
6. Aluminum is clearly the most valuable material recycled by the Blue Box Program. However, it currently accounts for less than 0.5% of the residential waste stream.
7. In 1987, 88 municipalities were served by 98 active recycling programs. There were 52 active recycling agents employing 287 full- or part-time staff, 10 of whom were physically or mentally challenged, and 207 volunteer workers.
8. Ontario employment related to the recycling industry is estimated at 3,400. Annual sales volumes are reported at \$590 million. Approximately 30% of the companies in US SIC5093 (Wholesale of Scrap and Waste Materials) have started business in the 1980-1989 period. In general, most of the companies surveyed as part of this study expected an increase in business resulting from recycling initiatives.
9. There are 31 Material Recovery Facilities (MRFs) in the province, most of which are located in Southern Ontario. These are operated by either the municipality, the private sector or the third sector (non-profit interest organizations). Fourteen of these employ 308 full-time and 17 part-time staff.
10. Anticipated trends in 3Rs include a greater focus on composting of organic wastes. These account for an estimated 32% of the residential MSW stream. Composting is currently being encouraged on two fronts, either by offering individual composters to households, or by curbside collection of kitchen and yard wastes, which are then processed in a centralized composting facility.
11. Bans on accepting materials such as drywall, OCC, wood wastes, white goods, etc. at landfills are expected to stimulate increased 3Rs of these waste streams.

12. Municipalities are being encouraged to expand the Blue Box Program beyond the traditional four materials (newspaper, glass, metal and PET). Some municipalities have included corrugated cardboard, phone books and household hazardous waste in their programs. Others are experimenting with including film plastic, boxboard, magazines and fine paper in their programs.
13. The available data indicate that a minimum of 279,760 tonnes of waste, or 5.2% of the ICI waste stream was recycled in 1989. It is suspected that the actual quantity may be higher than this value, however no reliable data are available to substantiate this option. More research should be carried out in this area.

APPENDIX A

References

Appendix A

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APPENDIX B

Dun & Bradstreet Survey

WASTE MATERIALS
#5323/90

DUN & BRADSTREET CANADA
5770 HURONTARIO STREET
MISSISSAUGA, ONTARIO
L5R 3G5
(416) 568-6162

ASK TO SPEAK TO THE PRESIDENT OR CONTROLLER

Good _____ it's _____ calling from Dun & Bradstreet.
We are conducting a survey about solid waste removal and
processing of recyclable materials in the Province of Ontario.

- 1a) First of all, which of the following types of business does
your company conduct in Ontario?
(READ LIST, CIRCLE AS MANY AS APPLY)

<u>HAULING</u> of non-hazardous, solid waste or recyclable materials	1	_ _ _
<u>PROCESSING</u> of recyclable materials.....	2	_ _ _
<u>OR</u> Some other activity(WRITE IN) _____		_ _ _
_____		_ _ _
_____		_ _ _
TOTAL 100%		↑

FOR EACH CATEGORY MENTIONED IN QU.1a), ASK QU.1b).

- 1b) And in Ontario, what percentage of
your business is.....(READ CATEGORY)
READ CATEGORY CITED AND
ASSIGN PERCENTAGE. ENSURE AMOUNT
TOTALS 100% _____

IF 100% IN OTHER, TERMINATE AND RECORD

- 2) What percentage of your total business is conducted in the
Province of Ontario (WRITE IN PERCENTAGE)

|_|_|_| %

- 3) Just thinking of your operations in Ontario, what is your
company's total annual operating costs? (WRITE IN)

\$ _____

- 4) In the future, as more waste reduction, reuse of materials, and recycling programs are implemented, how do you see the GROWTH OF YOUR BUSINESS. Do you think your business will have...(READ LIST, CIRCLE ONE ONLY).

Substantial Growth.....1

Slight Growth.....2

Stay the same.....3

Slight loss of Business.....4

OR Substantial Loss of Business.....5

- 5) In the future, as more waste reduction, reuse of materials, and recycling programs are implemented, how do you see your COMPANY'S COSTS CHANGING. Do you think your business will have.....(READ LIST, CIRCLE ONE ONLY)

Substantial Increase.....1

Slight Increase.....2

No change.....3

Slight decrease.....4

OR Substantial decrease.....5

**IF MORE THAN 1% IN SOLID WASTE REMOVAL, IN QU.1a, ASK SECTION I.
IF 0% IN SOLID WASTE REMOVAL ASK SECTION II.**

SECTION 1 (SOLID WASTE REMOVAL/HAULING)

- 6) Annually, what is the total amount of garbage, in metric tonnes, that your company HAULS AND DISPOSES of at landfills, incinerators, and transfer stations in Ontario? (WRITE IN TOTAL)

_____ tonnes

- 7) Annually, what is the total amount of recyclable materials, in metric tonnes that your company HAULS in Ontario? (WRITE IN TOTAL)

_____ tonnes

- 5). Which Ontario municipalities does your company haul
solid waste for?
(DO NOT READ, CIRCLE AS MANY AS APPLY).

AJAX.....1	NEWCASTLE.....27
BARRIE.....2	NEWMARKET.....28
BELLEVILLE.....3	NIAGARA FALLS.....29
BRAMPTON.....4	NORTH BAY.....30
BRANTFORD.....5	NORTH YORK.....31
BURLINGTON.....6	OAKVILLE.....32
CALEDON.....7	OSHAWA.....33
CAMBRIDGE.....8	OTTAWA.....34
CHATHAM.....9	PETERBOROUGH.....35
CORNWALL.....10	PICKERING.....36
CUMBERLAND TWP.....11	RICHMOND HILL.....37
EAST YORK.....12	SARNIA.....38
ETOBICOKE.....13	SAULT STE.MARIE.....39
GLOUCESTER.....14	SCARBOROUGH.....40
GUELPH.....15	ST.CATHARINES.....41
HALTON HILLS.....16	STONEY CREEK.....42
HAMILTON.....17	SUDBURY.....43
KANATA.....18	TIMMINS.....44
KINGSTON.....19	TORONTO.....45
KINGSTON TWP.....20	THUNDER BAY.....46
KITCHENER.....21	VAUGHAN.....47
LONDON.....22	WATERLOO.....48
MARKHAM.....23	WINDSOR.....49
MILTON.....24	WELLAND.....50
MISSISSAUGA.....25	WHITBY.....51
NEPEAN.....26	YORK.....52
OTHER _____	

- 9a) What percentage of solid waste HAULED by your company in Ontario is from the following sources?
(READ TYPE, AND ENTER PERCENTAGE).

	QU.9a %	Qu.9b \$/t
COMMERCIAL	_ _ _	\$ _____
INDUSTRIAL	_ _ _	\$ _____
RESIDENTIAL	_ _ _	\$ _____
<u>OR</u> ANY OTHER TYPE (WRITE IN)		
_____	_ _ _	\$ _____
_____	_ _ _	\$ _____
MUST TOTAL	100%	

FOR EACH TYPE MENTIONED IN QU.9a ASK QU.9b

- 9b) And, what price per metric tonne does your company charge to haul...(type of waste in Qu.9a)? (ENTER PRICE BESIDE TYPE MENTIONED)

- 10) What percentage of recyclable materials HAULED by your company in Ontario is from the following sources?
(READ SOURCE AND ENTER PERCENTAGE. ENSURE TOTAL IS 100%)

	%
COMMERCIAL	_ _ _
INDUSTRIAL	_ _ _
RESIDENTIAL	_ _ _
OTHER (WRITE IN) _____	_ _ _
_____	_ _ _
	100%

11a: I am going to read you a list of typical trucks used in the hauling of solid waste materials. I would like you to tell me the size or capacity of truck that your company uses for the hauling of solid waste. The first truck is.....(READ LIST). What other sizes?.....(ENTER SIZE OR CAPACITY VERBATIM).

	QU.11a SIZE/CPY	QU.11b NUMBER
CLOSED BODY COMPARTMENTALIZED HYDRAULIC TOP-LOADING.	_____	_____
CLOSED BODY COMPARTMENTALIZED OPEN SIDED	_____	_____
PACKER TRUCK FRONT LOADING	_____	_____
PACKER TRUCK REAR LOADING	_____	_____
PACKER TRUCK SIDE LOADING	_____	_____
OR ANY OTHER TYPE (WRITE IN)		
_____	_____	_____
_____	_____	_____
	_____	_____
	_____	_____

FOR EACH TYPE OF TRUCK MENTIONED IN QU.11a, ASK QU.11b)

11b) And how many (TYPES OF TRUCK) trucks does your company use to haul solid waste in Ontario (ENTER NUMBER BESIDE TYPE MENTIONED IN QU.11a)

IF 0% IN RECYCLABLE MATERIALS IN QU.1b TERMINATE AND RECORD

SECTION 11 - PROCESSING OF RECYCLABLE MATERIALS

12) Annually, how many metric tonnes of recyclable materials does your company process in Ontario? (WRITE IN)

_____ t

13) What percentage of recyclable materials PROCESSED by your company in Ontario is from the following sources?
(READ LIST, ENTER PERCENTAGE)

COMMERCIAL	1_1_1_1_1
INDUSTRIAL	1_1_1_1_1
RESIDENTIAL	1_1_1_1_1
OTHER (WRITE IN) _____	1_1_1_1_1
_____	1_1_1_1_1
MUST TOTAL	100%

14a) What percentage of the recyclable materials PROCESSED by your company in Ontario are of the following type?
(READ LIST, ENTER PERCENTAGE)

	QU.14a %	QU.14b \$/mt
ALUMINUM	1_1_1_1_1	\$ _____
CORRUGATED CARDBOARD	1_1_1_1_1	\$ _____
DRYWALL	1_1_1_1_1	\$ _____
FINE/OFFICE PAPER	1_1_1_1_1	\$ _____
GLASS	1_1_1_1_1	\$ _____
NEWSPAPER	1_1_1_1_1	\$ _____
PLASTIC	1_1_1_1_1	\$ _____
RUBBER TIRES	1_1_1_1_1	\$ _____
TINPLATE STEEL	1_1_1_1_1	\$ _____
WOOD WASTE	1_1_1_1_1	\$ _____
<u>OR</u> ANY OTHER TYPES(WRITE IN)		\$ _____
_____	1_1_1_1_1	\$ _____
_____	1_1_1_1_1	\$ _____

FOR EACH TYPE MENTIONED IN QU.14a ASK QU 14b)

14b) And what price does your company charge per metric tonne for PROCESSING of.....
(READ TYPE MENTIONED IN QU.14a)? (ENTER PRICE BESIDE TYPE) _____

15) Which Ontario municipalities does your company process
recyclable materials for?
(DO NOT READ, CIRCLE AS MANY AS APPLY).

AJAX.....1	NEWCASTLE.....27
BARRIE.....2	NEWMARKET.....28
BELLEVILLE.....3	NIAGARA FALLS.....29
BRAMPTON.....4	NORTH BAY.....30
BRANTFORD.....5	NORTH YORK.....31
BURLINGTON.....6	OAKVILLE.....32
CALEDON.....7	OSHAWA.....33
CAMBRIDGE.....8	OTTAWA.....34
CHATHAM.....9	PETERBOROUGH.....35
CORNWALL.....10	PICKERING.....36
CUMBERLAND TWP.....11	RICHMOND HILL.....37
EAST YORK.....12	SARNIA.....38
ETOBICOKE.....13	SAULT STE.MARIE.....39
GLOUCESTER.....14	SCARBOROUGH.....40
GUELPH.....15	ST.CATHARINES.....41
HALTON HILLS.....16	STONEY CREEK.....42
HAMILTON.....17	SUDBURY.....43
KANATA.....18	TIMMINS.....44
KINGSTON.....19	TORONTO.....45
KINGSTON TWP.....20	THUNDER BAY.....46
KITCHENER.....21	VAUGHAN.....47
LONDON.....22	WATERLOO.....48
MARKHAM.....23	WINDSOR.....49
MILTON.....24	WELLAND.....50
MISSISSAUGA.....25	WHITBY.....51
NEPEAN.....26	YORK.....52

OTHER _____

16a) Currently, how many of the following types of recycling equipment are currently in use by your company in Ontario? (READ LIST AND ENTER NUMBER FOR EACH TYPE MENTIONED).

	NUMBER	MANUFACTURED IN ONTARIO	
		YES	NO
AIR CLASSIFIERS	_____	1	2
BALERS	_____	1	2
CONVEYORS	_____	1	2
GLASS CRUSHERS	_____	1	2
PAPER SHREDDERS	_____	1	2
MAGNETIC SEPARATORS	_____	1	2
METAL DENSIFIERS	_____	1	2
METAL FLATTENERS	_____	1	2
PLASTIC GRANULATORS	_____	1	2
OTHER (WRITE IN) _____	_____	1	2
	_____	1	2
	_____	1	2

FOR EACH TYPE MENTIONED IN QU.16a, ASK QU.16b

16b) And was the (READ TYPE OF MACHINERY) manufactured in Ontario? (CIRCLE EITHER YES OR NO) _____

17) Finally I'd just like to confirm your name and title as well as the company's address and phone number. (RECORD RESPONDENT'S NAME AND TITLE. RECORD COMPANY NAME AND ADDRESS FROM DMI).

CONTACT NAME _____

CONTACT TITLE _____

COMPANY NAME _____

COMPANY ADDRESS _____

COMPANY PHONE _____

THANK YOU FOR YOUR TIME AND HELP!!!

INTERVIEWER | _ | _ |

DATE | _ | _ | _ | _ |
D D M M

QUALITY CHECKED BY: _____

DATE | _ | _ | _ | _ |
D D M M

APPENDIX C
Recycling Funding

Appendix C

DESCRIPTION OF FUNDING PROGRAMS FOR RECYCLING ACTIVITIES

OMMRI Financial Support

The Ontario Multi-Material Recycling Inc.(OMMRI) was created in 1986 by the soft drink industry and its container suppliers to ensure compliance with Ontario soft drink container recycling regulations. Throughout recent years, the OMMRI mandate has been to encourage the development of multi-material recycling throughout Ontario with emphasis on recycling soft drink containers. Since its conception, OMMRI has expanded to include other food and container representatives: The Ontario Printing Paper Users Group, Canadian Council of Grocery Distributors, Grocery Products Manufacturers of Canada, Society of Plastics Industry of Canada and the Packaging Association of Canada. The expanded group works under the revised title - OMMRI: Corporations in Support of Recycling (OMMRI II).

OMMRI (and OMMRI II) contributes to the establishment of municipal recycling programs by funding up to one-third for the start up costs of Blue Boxes, recycling trucks and processing centres.

MOE Municipal Recycling Support Program (MRSP)

Along with OMMRI, the Ministry of the Environment offer to reimburse one-third of the capital costs incurred by the municipality for the curbside collection program. However, only the MRSP offers to share the operating costs by paying, in the first year, up to 50% of the operating costs incurred by the municipality and then, up to 40%, 30%, 20% and 10% for each subsequent year.

Although the MRSP programs is geared towards the development of multi-material curbside collection programs, grants have been set aside under the auspices of the MRSP to facilitate program expansion. Other grants include:

- Household Bins - Recognizing the high upfront expenditures associated with Blue Box programs, the MOE provides grants for up to one-third of the cost of the collection bins.

- Promotion and Advertising - An integral component of any multi-material recycling program is the establishments of an aggressive and informative advertising program. Depending on the size and density of the targeted population, a variety of activities are available to promote the recycling program. With this in mind, the MOE offers two payment options to the municipalities - up to 50% of the costs or a maximum of \$0.10/capita/year for five years.
- Demonstration Project - Grants of up to 100% of the cost of the demonstration project is available for innovative, experimental recycling projects. The project emphasizes research and data collection activities. Due to the originality of the project, a wide range of programs have received funding to date including: Cobourg's user pay system approach, Durham's program to promote fine paper recycling in the corporation and commercial sectors, and Peterborough's project to incorporate plastic film in the Blue Box program.
- Education Project - Grants of up to \$15,000 are available for municipalities wanting to implement educational programs aimed at increasing awareness and understanding of, and participation in 3R activities.
- Feasibility - Initial program development requires an assessment of costs, equipment and facility needs. The MOE helps municipalities with the costs of a feasibility study by providing funds up to 50% of the cost.

MNDM Municipal Recycling Support Program

The Ministry of Northern Development and Mines (MNDM) has instituted a joint program with the MOE to provide additional capital assistance to help northern municipalities begin recycling in their communities. The MOE will administer the funds as part of their MRSP although, along with MNDM, it recognizes the need to remain flexible with funding, particularly with smaller municipalities, where per capita costs may be unavoidably high. This additional funding is provided for a number of specific areas using the following formula:

- | | | |
|---------------------------------------|---|---|
| • Collection and Processing Equipment | - | MOE 1/3, OMMRI 1/3, MNDM 1/6, Municipality 1/6; |
| • Collection Bins | - | MOE 1/3, OMMRI 1/3, MNDM 1/6, Municipality 1/6; |
| • Building Construction | - | MOE 1/3, MNDM 1/3, Municipality 1/3. |

MOE - Municipal Recovery Program

The Ministry of the Environment initiated the Municipal Recovery Program in June 1987 to encourage municipalities to set up recovery programs for wastes disposed in landfills. The program provides capital grants for processing facilities to recover traditional curbside recyclable materials (newspaper, glass, metal, plastic) as well as other materials from mixed (unsorted) solid waste (compost, paper). Large scale municipal composting of organics and material processing plants would be eligible for these grants. The program funds up to one third of the in-service capital costs (feasibility studies, design, approval construction, and commissioning) and up to 100% of the costs of research, development and demonstration projects. Municipalities must submit the proposal and in the case of private sector contracts, the proposal may be submitted from the municipality concerned.

MOE- Municipal Reduction/Reuse Program

This program, initiated in 1987, is intended to encourage greater awareness of buying habits and products that can reduce waste production rates. This program completes the agenda for MOE funding programs aimed at diverting waste from landfill through 3R (reduce, reuse, recycle) initiatives. Assistance is available for projects to alter consumer waste generating behaviour such as home composting and package substitution. Municipalities, private sector organizations and individuals are eligible for up to 50% of capital and promotional costs as well as up to 100% of creative educational projects to a limit of \$25,000 per project. As with the other funding programs, the MOE evaluates the application according to the scope of the project and the potential to impact on the quantity and quality of the municipal waste stream.

FAP - MOE Comprehensive Funding Program

The Financial Assistance Program (FAP) covered under the MOE comprehensive funding program, provides funds to assist municipalities develop new landfill sites, transfer stations and processing facilities and to expand existing facilities. Eligible activities range from initial facility design to capital costs of construction. The amount and duration of funding through FAP depends on the number of people served by the facility. Municipalities and Counties are eligible for up to 60% of the total costs of the facility.

Student Action For Recycling (STAR)

Student Action for Recycling (STAR) was initiated in October 1988 to facilitate increased student awareness of and participation in waste minimization activities. The STAR program promotes the introduction of multi-material recycling into the schools. School boards may apply for assistance on behalf of the school for two-thirds the

capital cost associated with collection and storage and half of the co-ordinator's salary for the first year.

Table C.1 MINISTRY OF THE ENVIRONMENT - 3'R's FUNDING PROGRAMS

Program	Program brief	Type	Eligibility	Grant Information*
			Municipal	Private sector
Municipal Recycling Support Program	Provides assistance to municipalities and others in the development and management of local recycling initiatives that will reduce waste disposal requirements and provide other environmental benefits to Ontario.	• Operating cost grant • Capital cost grant • Household bins • Promotion & advertising • Education Grant • Demonstration grant • Feasibility Study	✓ ✓ ✓ ✓ ✓ ✓ ✓	- up to 5 yrs (50%-1st year, 40, 30, 20, 10%-5th year) - 1/3 (land, land improvements, and existing assets not eligible) - 1/3 (maximum replacement @ 2%/yr. over 5 yrs.) - up to 50 % or \$0.10/capita/year max. over 5 yrs. - case-by-case, up to \$ 15,000 - up to 100 % of the cost to advance state-of-the-art technology through pilot programs - up to 50 % of the cost required to plan and analyze recycling projects
Municipal Reduction Reuse Program	Encourage greater awareness of buying habits and products that will reduce waste production rates. Assistance may be obtained for projects to alter consumer waste generating behavior, such as, home composting, packaging, new product approaches. Private sector and individuals are eligible for projects aimed at reduction or reuse of waste materials that would otherwise be directed to municipal landfill. (before the material enters the waste stream)	• Capital cost grant • Promotion & advertising • Creative projects	✓ ✓ ✓	- up to 50 % - up to 50 % - up to 100 % of creative/innovative materials or projects (max. \$25,000)
Municipal Recovery Program	To recover materials from the waste stream. Assistance may be obtained for projects to establish facilities to recover or process paper, refuse derived fuel, compost, aluminum, steel, glass, plastic or other materials.	• Demonstration grant • Capital grant	✓ ✓	- up to 100% of costs for period necessary to demonstrate the project - up to 1/3 for feasibility, design, approval, construction and commissioning
Student Action for Recycling	To increase students awareness of waste management, through direct action, by introducing recycling into educational institutions. The Student Action for Recycling Program is intended to be operated in conjunction with the local municipal recycling system. School boards may apply for assistance on behalf of schools in their jurisdiction.	• Capital grant	✓	- 2/3 of capital costs for collection, storage, construction and safety equipment. - 1/2 of co-ordinators salary for 1st year (\$20,000 max.) *Application should be filed with the Board of Directors only. However, at the request of the Board, municipalities may apply for 100% funding for a collection vehicle(s) dedicated to servicing the Board.

APPENDIX D

The Municipal Solid Waste Database

Appendix D

THE MUNICIPAL SOLID WASTE DATABASE

D.1 GENERAL

The purpose of this appendix is to describe in greater detail the structure and use of the database created as part of this study. The following issues need to be addressed:

- General information regarding the capabilities and use of dBASE IV.
- Description of each file constituting the database, including the following:
 - source of information and its completeness
 - nature of data (i.e., character or logical information, estimated or actual quantities, etc.)
 - coding of information in the file and how each file may be connected to others in the database
 - assumptions and limitations of the data
- Updating of information in the database.

D.2 GENERAL INFORMATION ON dBASE IV

In order to assist those who are unfamiliar with dBASE IV, this section provides a brief summary of some of its capabilities and uses.

In dBASE IV, raw data are stored in files with a **.DBF** extension to the filename.

Example: All raw data on residential generation rates for each municipality in the province is stored in the file **RESIDENT.DBF**.

Each .DBF file may be thought of as a large table, where rows are referred to as *records* and columns are referred to as *fields*. Column headings are referred to as *field names*.

Example: The file LANDFILL.DBF provides information on 730 landfills. Thus the file contains 730 records. Up to 50 different pieces of information are available on each landfill. Thus the file contains 50 fields for each record.

The description of the structure of each database, as presented at the end of this Appendix provides information on the records and fields of all database files.

Example: Referring to the appropriate structure description at the end of this Appendix, the file RECYCLE.DBF contains 46 records and 24 fields. The field "CTY" contains numerical information and is 5 digits wide. This field contains the 5 digit code which identifies the county for each record. The field "CONTACT" contains character information and is 30 characters wide. This field provides the name of a municipal official who can be contacted regarding recycling for that municipality. The field "BBOX-PROG" contains logical information and is 1 character wide. This field provides yes/no or true/false information on the existence of Blue Box programs for each municipality.

Information in database files may be coded to reduce the amount of memory required to store the information, to avoid problems such as inconsistent spelling and abbreviations and, most importantly, to provide a link between files containing information on a common subject.

Example: Wherever possible throughout the database files, municipalities and counties have been given a unique five digit code. Thus it is possible to print all information related to a particular municipality from several different files, including:

- AGENT1.DBF
- CTYCODE.DBF
- ICICTY87.DBF
- ICICTY89.DBF
- LANDFILL.DBF
- MRF.DBF
- MUNCODE.DBF
- RECYCLE.DBF
- TRANSFER.DBF
- RESIDENT.DBF

Data in .DBF files are stored in the order in which they are entered. In order to sort the data in numerical or alphabetical order, the dBASE IV function *Queries* may be used. In addition, files containing common coded information may be linked and new *calculated fields* may be created through mathematical manipulation of existing fields. The use of calculated fields minimizes the amount of memory required to store the database files.

Example: The data contained in RESIDENT.DBF is identified by municipality and county numerical codes. In order to sort the data *alphabetically* by county and then by municipality, the Queries function may be used to *link* RESIDENT.DBF to MUNCODE.DBF and CTYCODE.DBF, where the names of municipalities and counties are stored as character fields. The *sort* is then also executed by the Queries function. Data on quantities of individual components of the waste stream, such as newsprint, may be generated by linking RESIDENT.DBF to files on waste stream composition (RESCOM87.DBF and RESCOM89.DBF) and creating *calculated fields* that multiply total amount by composition to give amount of each component.

Queries are also useful in printing *Reports*. Any given field of information may be included or excluded from the printed report, fields from different .DBF files and calculated fields may be printed on the same page through linking and printed reports may be sorted alphabetically or numerically. The Report function allows custom designing of what the printed page will look like. For example, different page sizes can be accommodated, depending on the printer in use, and margins, page breaks, column widths as well as other print functions can be selected. In addition, the Reports function provides for automatic subtotalling and totalling of numeric columns, among other arithmetic functions.

It is important to note that, for the most part, the preceding is a description of dBASE IV capabilities which are not peculiar to the MSW database. The purpose of selecting a widely available software package was to take advantage of built-in capabilities such as these. This is by no means a comprehensive description of dBASE IV's capabilities. However, it does point out some the most important functions that were used to advantage in developing the study database and in analyzing the available data.

D.3 MUNICIPAL SOLID WASTE DATABASE FILES

D.3.1 Quantity and Composition Files

RESIDENT.DBF

Description

- For each municipality, data for 1987 and 1989 populations and residential generation rates (per capita) and quantities are provided. Either generation rate or quantity may be updated if better data become available, however, both should be changed in that instance. This can be accomplished through the population data provided. In other words, if generation rate data are changed, total quantities should be recalculated by

multiplying by population, and vice versa. This may be accomplished through dBASE IV commands rather than by long-hand calculations.

Source

- Residential generation rates are taken from WMMPs, where available.
- Population figures are taken from *Demographic Bulletin* published by the Ministry of Treasury and Economics (July, 1989).

Assumptions

- Generation rates have been assumed for those records where no data are available. In these cases, the field ASSUMRES is assigned the value "yes". Such entries are made for less than half of the province's population. The assumed values chosen are those required to yield the provincial totals presented in Table 3.4 of this report. Further discussion may be found in Section 3.2.3.

Coding

- Each record contains five digit codes to identify both municipality and county. This allows linking to a number of other files as listed in Section D.2.
- Links to files on waste composition are also provided.

ICICTY87.DBF AND ICICTY89.DBF

Description

- ICI waste quantities by IMC and county for 1987 and 1989 as presented in Section 3.3.

Source

- These are the estimates based on employee generation rates and employment data as presented in Table 3.10, broken down by county. For discussion, see Section 3.3.4.

Assumptions

- See Section 3.3.4.

Coding

- Counties are identified by their five digit code. In three instances, quantities for more than one county are combined. Additional fields are provided for more than one county code.

ICICPT87.DBF AND ICICPT89.DBF

Description

- ICI waste quantities by IMC and component for 1987 and 1989 as presented in Section 3.3 of this report.

Source

- As for ICICTY87.DBF and ICICTY89.DBF.

Assumptions

- See Section 3.3.4.

Coding

- No coding of this information was possible.

RECYCLE.DBF

Description

- Residential recycled waste quantities by municipality and county as presented in Table 3.14.

Source

- See Section 3.4.

Assumptions

- See Section 3.4.

Coding

- County and municipality are identified by five digit code.
- Agent is identified by one or two digit code for linking with AGENT1.DBF.

RESCOM87.DBF AND RESCOM89.DBF

Description

- Data on residential waste composition for 1987 and 1989, as presented in Table 3.3.

Source

- See Section 3.2.

Assumptions

- See Section 3.2.

Coding

- These fields are coded to link with RESIDENT.DBF on the COMP87 and COMP89 fields. In this way, total quantities from RESIDENT.DBF may be multiplied by composition from RESCOM87.DBF or RESCOM89.DBF to produce quantities of individual waste components as presented in Table 3.4. As noted earlier, this may be accomplished through the creation of calculated fields in the Queries function.

D.3.2 Waste Management Facilities Files

LANDFILL.DBF

Description

- Information on 730 landfills, including site, location, operator, municipalities serviced, wastes accepted and amounts, remaining life and economic data.

Source

- MOE Site Summary Reports (SSRs) on landfills in southern Ontario.
- WMMPs provided some data to update SSRs.
- MOE Approvals Branch identified major landfills serving more than 1,500 people in the Northeastern Region.
- MOE Northwestern Regional office identified major landfills serving more than 1,000 people.
- VHB/MacLaren survey (received more than 200 responses from landfills identified in the SSRs).

Assumptions

- See Section 4.2.2.

Coding

- Municipalities serviced are identified by the five digit code, as well as county and site location.

MRF.DBF

Description

- Information on 14 MRFs including location, contact, economic data, activities, materials handled and municipalities served.

Source

- VHB/MacLaren survey.

Assumptions

- See Section 5.3.2.

Coding

- Location and municipalities served are identified by five digit code.
- Agent operating the MRF is identified by one or two digit code for linking to AGENT1.DBF.

TRANSFER.DBF

Description

- Information on 29 transfer stations including location, operator, municipality served, and waste destination.

Source

- WMMPs.

Coding

- Location and municipalities served are identified by five digit code.

D.3.3 Waste Pathways Files

AGENT1.DBF

Description

- Information on 80 recycling agents involved in municipal recycling programs, including municipalities served, contact names and economic data, see discussion in Section 5.4.2.

Source

- Recycling Council of Ontario, 1987. *Municipal Source Separation Programs in Ontario*.
- MOE Waste Management Branch.
- VHB/MacLaren survey of MRFs.

Coding

- Agent numbers provide links to RECYCLE.DBF and MRF.DBF.
- Municipalities served are identified by five digit code.

AGENT2.DBF

Description

- Information on 295 recycling agents including materials handled and function (dealer, broker, transport, disposal, etc.).
- See discussion in Section 5.4.2.

Source

- *Recoup's Canadian Recyclers Directory*, 1987

Coding

- None applicable.

EQUIP.DBF

Description

- Information on 44 equipment suppliers including address and type of equipment.

Source

- *OWMA Members Directory, 1989.*

Coding

- None applicable.

HAULER.DBF

Description

- Information on 123 haulers in Ontario, including type of waste handled, operation of landfills or transfer stations and involvement in recycling activities. Purported to account for 85% of the waste handled in Ontario.

Source

- *OWMA Members Directory, 1989.*

Coding

- None applicable.

SIC5093.DBF

Description

- Information on 285 waste material wholesalers including employment, sales figures and descriptions of type of business in words and by SIC.

Source

- *Dun & Bradstreet Canadian DMI System Tape Record.*

Coding

- None Applicable.

SIC4953A.DBF

Description

- Information on 230 haulers and recyclers (and other businesses grouped under "Refuse Systems") including employment, sales figures and descriptions of type of business in words and by SIC.

Source

- *Dun & Bradstreet Canadian DMI System Tape Record.*

Coding

- None Applicable.

SIC4953B.DBF

Description

- Information on 65 haulers and recyclers (and other businesses grouped under "Refuse Systems") including employment, sales figures, descriptions of type of business in words and by SIC and telephone survey responses.

Source

- *Dun & Bradstreet Canadian DMI System Tape Record.*
- Dun & Bradstreet telephone survey (see Survey form in Appendix B).

Coding

- This information was originally coded by Dun & Bradstreet for use in the SAS statistical analysis package. A complete listing of those results is available on request.
- No other coding applicable.

EPI SOURCING DATABASE

Description

- Information on approximately 1,700 firms in the Ontario Environment Protection Industry (EPI) including services provided.

Source

- Ministry of Industry, Trade and Technology. This database was developed as part of Woods Gordon's study of the EPI for the MOE.

Coding

- None applicable.
- This database is not in dBASE IV format. The file EPIREAD.ME provides installation and operation instructions. Four other files make up the database:
 - ONTARIO.BAT
 - ONTARIO.ZIP
 - PKZIP.EXE
 - PKUNZIP.EXE

D.3.4 Coding Files

CTYCODE.DBF AND MUNCODE.DBF

Source

- Five digit codes for identifying county and municipality were taken from the *Municipal Directory*, 1989, published by the Ministry of Municipal Affairs.

Coding

- These files are used to print out county and municipality names, rather than five digit codes, by linking to the file with the information of interest.

D.4.**DATABASE UPDATING**

The MSW database has no built-in updating capabilities. In other words, no special input or output screens have been developed to allow for tracking of the waste management system over time and no provision for including the date of any changes has been made. However, the .DBF files may be edited to bring information up-to-date. Documentation of any changes and any sources of new information would remain the responsibility of the database users.

It is important to note that updates to one database do not correct information in related databases. For example, if total amounts of ICI waste for some counties are adjusted in ICICTY89.DBF, the provincial totals will change. However, the province totals provided by ICICPT89.DBF will not automatically be adjusted, since this would involve a complex iterative procedure, as indicated by the discussion of Section 3.3.2. This is an important limitation of the MSW database, however, it should be noted that any calculated fields created under the Queries function as well as any reports would be automatically updated when data are adjusted.

Structure for database: C:\MOEMS\AGENT1.DBF

Number of data records: 80

Date of last update : 11/07/90

Field	Field Name	Type	Width	Dec	Index
1	AGENTNO	Numeric	2		N
2	AGENTNAME	Character	30		N
3	TYPE	Character	1		N
4	ACTIVE87	Logical	1		N
5	ADDRESS	Character	30		N
6	CITY	Character	20		N
7	POSTALCODE	Character	7		N
8	EMPLOYEE	Numeric	4	1	N
9	VOLUNTEER	Numeric	4	1	N
10	HANDICAP	Numeric	4	1	N
11	CONTACT	Character	30		N
12	PHONE	Character	13		N
13	COST1987	Numeric	7		N
14	OPER1988	Numeric	7		N
15	CAP1988	Numeric	7		N
16	OPER1989	Numeric	7		N
17	CAP1989	Numeric	7		N
18	MUN1	Numeric	7		N
19	MUN2	Numeric	7		N
20	MUN3	Numeric	7		N
21	MUN4	Numeric	7		N
22	MUN5	Numeric	7		N
23	MUN6	Numeric	7		N
24	MUN7	Numeric	7		N
25	MUN8	Numeric	7		N
26	MUN9	Numeric	7		N
27	MUN10	Numeric	7		N
28	MUN11	Numeric	7		N
29	MUN12	Numeric	7		N
30	MUN14	Numeric	7		N
31	MUN15	Numeric	7		N
32	MUN16	Numeric	7		N
33	MUN17	Numeric	7		N
34	MUN18	Numeric	7		N
35	MUN19	Numeric	7		N
36	MUN20	Numeric	7		N
37	MUN21	Numeric	7		N

** Total **

322

Structure for database: C:\MODEMS\AGENT2.DBF

Number of data records: 295

Date of last update : 11/08/90

Field	Field Name	Type	Width	Dec	Index
1	NAME	Character	45		N
2	ADDRESS	Character	35		N
3	CITY	Character	25		N
4	POSTAL	Character	7		N
5	PHONE	Character	13		N
6	COUNTY	Character	15		N
7	PAPER	Logical	1		N
8	GLASS	Logical	1		N
9	METAL	Logical	1		N
10	PLASTIC	Logical	1		N
11	BROKER	Logical	1		N
12	DEALER	Logical	1		N
13	DISPOSAL	Logical	1		N
14	TRANSPORT	Logical	1		N
15	IMPORTER	Logical	1		N
16	MILL	Logical	1		N
17	PACKER	Logical	1		N
18	PROCESSOR	Logical	1		N
19	TRANSFERS	Logical	1		N
20	FERROUS	Logical	1		N
21	NONFERROUS	Logical	1		N
** Total **			156		

Structure for database: C:\MOEMSW\CTYCODE.DBF

Number of data records: 50

Date of last update : 06/27/90

Field	Field Name	Type	Width	Dec	Index
1	CTYNAME	Character	20		N
2	CTY	Numeric	6		Y
** Total **			27		

Structure for database: C:\MOENSW\EQUIP.DBF

Number of data records: 44

Date of last update : 08/15/90

Field	Field Name	Type	Width	Dec	Index
1	COMPANY	Character	35		N
2	STREET	Character	35		N
3	CITY	Character	20		N
4	POSTALCODE	Character	7		N
5	PHONE	Character	13		N
6	EQUIP1	Character	30		N
7	EQUIP2	Character	30		N
8	EQUIP3	Character	30		N
9	EQUIP4	Character	30		N
10	EQUIP5	Character	30		N
11	EQUIP6	Character	30		N
12	EQUIP7	Character	30		N
13	EQUIP8	Character	30		N
14	EQUIP9	Character	30		N
15	EQUIP10	Character	30		N
** Total **			411		

Structure for database: C:\MOEHSW\HAULER.DBF

Number of data records: 123

Date of last update : 11/02/90

Field	Field Name	Type	Width	Dec	Index
1	COMPANY	Character	35		N
2	ADDRESS	Character	30		N
3	CITY	Character	20		N
4	COUNTY	Character	20		N
5	POSTALCODE	Character	7		N
6	PHONE	Character	13		N
7	CONTACT	Character	30		N
8	DOMESTIC	Logical	1		N
9	INDCOMM	Logical	1		N
10	LANDFILL	Logical	1		N
11	TRANSFERS	Logical	1		N
12	RECYCLING	Logical	1		N
** Total **			161		

Structure for database: B:\ICICPT87.DBF

Number of data records: 10

Date of last update : 02/11/91

Field	Field Name	Type	Width	Dec	Index
1	WASTETYPE	Character	13		N
2	IMC1	Numeric	12		N
3	IMC2	Numeric	12		N
4	IMC3	Numeric	12		N
5	IMC4	Numeric	12		N
6	IMC5	Numeric	12		N
7	IMC6	Numeric	12		N
8	IMC7	Numeric	12		N
9	IMC8	Numeric	12		N
10	IMC9	Numeric	12		N
11	IMC10	Numeric	12		N
12	IMC11	Numeric	12		N
13	IMC12	Numeric	12		N
14	IMC13	Numeric	12		N
15	IMC14	Numeric	12		N
16	IMC15	Numeric	12		N
17	IMC16	Numeric	12		N
18	IMC17	Numeric	12		N
19	IMC18	Numeric	12		N
20	IMC19	Numeric	12		N
21	IMC20	Numeric	12		N
22	IMC21	Numeric	12		N
23	IMC22	Numeric	12		N
24	IMC23	Numeric	12		N
25	IMC24	Numeric	12		N
26	IMC25	Numeric	12		N
27	TOTAL	Numeric	12		N
** Total **			326		

Structure for database: B:\IC\IPT89.DBF

Number of data records: 10

Date of last update : 02/11/91

Field	Field Name	Type	Width	Dec	Index
1	WASTETYPE	Character	13		N
2	IMC1	Numeric	12		N
3	IMC2	Numeric	12		N
4	IMC3	Numeric	12		N
5	IMC4	Numeric	12		N
6	IMC5	Numeric	12		N
7	IMC6	Numeric	12		N
8	IMC7	Numeric	12		N
9	IMC8	Numeric	12		N
10	IMC9	Numeric	12		N
11	IMC10	Numeric	12		N
12	IMC11	Numeric	12		N
13	IMC12	Numeric	12		N
14	IMC13	Numeric	12		N
15	IMC14	Numeric	12		N
16	IMC15	Numeric	12		N
17	IMC16	Numeric	12		N
18	IMC17	Numeric	12		N
19	IMC18	Numeric	12		N
20	IMC19	Numeric	12		N
21	IMC20	Numeric	12		N
22	IMC21	Numeric	12		N
23	IMC22	Numeric	12		N
24	IMC23	Numeric	12		N
25	IMC24	Numeric	12		N
26	IMC25	Numeric	12		N
27	TOTAL	Numeric	12		N
** Total **			326		

Structure for database: B:\ICICTY87.DBF

Number of data records: 44

Date of last update : 02/11/91

Field	Field Name	Type	Width	Dec	Index
1	COUNTY1	Numeric	5		N
2	COUNTY2	Numeric	5		N
3	COUNTY3	Numeric	5		N
4	COUNTY4	Numeric	5		N
5	IMC1	Numeric	12		N
6	IMC2	Numeric	12		N
7	IMC3	Numeric	12		N
8	IMC4	Numeric	12		N
9	IMC5	Numeric	12		N
10	IMC6	Numeric	12		N
11	IMC7	Numeric	12		N
12	IMC8	Numeric	12		N
13	IMC9	Numeric	12		N
14	IMC10	Numeric	12		N
15	IMC11	Numeric	12		N
16	IMC12	Numeric	12		N
17	IMC13	Numeric	12		N
18	IMC14	Numeric	12		N
19	IMC15	Numeric	12		N
20	IMC16	Numeric	12		N
21	IMC17	Numeric	12		N
22	IMC18	Numeric	12		N
23	IMC19	Numeric	12		N
24	IMC20	Numeric	12		N
25	IMC21	Numeric	12		N
26	IMC22	Numeric	12		N
27	IMC23	Numeric	12		N
28	IMC24	Numeric	12		N
29	IMC25	Numeric	12		N
30	TOTAL	Numeric	12		N
** Total **			333		

Structure for database: C:\MOEMSW\LANDFILL.DBF

Number of data records: 730

Date of last update : 11/13/90

Field	Field Name	Type	Width	Dec	Index
1	COUNTY	Numeric	9		N
2	CERTHOLD	Character	30		N
3	STREET1	Character	30		N
4	CITY1	Character	15		N
5	OPERATOR	Character	30		N
6	STREET2	Character	30		N
7	CITY2	Character	15		N
8	POSTCODE1	Character	7		N
9	POSTCODE2	Character	7		N
10	PHONE	Character	13		N
11	SITELOC	Numeric	9		N
12	CONCESS	Character	8		N
13	LOTNO	Character	10		N
14	NTS	Character	7		N
15	TONNAGE	Numeric	8		N
16	MUN1	Character	9		N
17	POP1	Numeric	8		N
18	MUN2	Numeric	9		N
19	POP2	Numeric	8		N
20	MUN3	Numeric	9		N
21	POP3	Numeric	8		N
22	MUN4	Numeric	9		N
23	POP4	Numeric	8		N
24	MUN5	Numeric	9		N
25	POP5	Numeric	8		N
26	MUN6	Numeric	9		N
27	POP6	Numeric	8		N
28	MUN7	Numeric	9		N
29	POP7	Numeric	8		N
30	MUN8	Numeric	9		N
31	POP8	Numeric	8		N
32	MUN9	Numeric	9		N
33	POP9	Numeric	8		N
34	MUN10	Numeric	9		N
35	POP10	Numeric	8		N
36	LIFE	Numeric	2		N
37	STARTDATE	Numeric	4		N
38	DOMESTIC	Numeric	7		N
39	COMMERCIAL	Numeric	7		N
40	NONHAZ	Numeric	7		N
41	REMLIFE	Numeric	5	1	N
42	AREA	Character	10		N
43	WASTESOURC	Character	7		N
44	RESWASTE	Logical	1		N
45	ICIWASTE	Logical	1		N
46	CAPITAL	Numeric	10		N
47	OPERATING	Numeric	10		N
48	FULL	Numeric	2		N
49	PART	Numeric	2		N
50	TIP89	Character	12		N

** Total **

486

Structure for database: C:\MOEMSV\MRF.DBF

Number of data records: 15

Date of last update : 11/15/90

Field	Field Name	Type	Width	Dec	Index
1	COUNTY	Numeric	5		N
2	MUN	Numeric	5		N
3	AGENTNO	Numeric	3		N
4	NAME	Character	30		N
5	POSITION	Character	30		N
6	FACILITY	Character	30		N
7	ADDRESS	Character	30		N
8	CITY	Character	30		N
9	PHONE	Character	13		N
10	FULL	Numeric	2		N
11	PART	Numeric	2		N
12	CAPITAL	Character	10		N
13	OPERATING	Character	10		N
14	ACTIVITY1	Character	25		N
15	ACTIVITY2	Character	25		N
16	ACTIVITY3	Character	25		N
17	ACTIVITY4	Character	25		N
18	ACTIVITY5	Character	25		N
19	ACTIVITY6	Character	25		N
20	ACTIVITY7	Character	25		N
21	WASTESOURC	Character	7		N
22	RESWASTE	Logical	1		N
23	ICIWASTE	Logical	1		N
24	PACP	Logical	1		N
25	PAOCC	Logical	1		N
26	CD	Logical	1		N
27	GLFB	Logical	1		N
28	HHW	Logical	1		N
29	ALFL	Logical	1		N
30	ALFB	Logical	1		N
31	TSFB	Logical	1		N
32	PAMAGHIX	Logical	1		N
33	PATB	Logical	1		N
34	PANP	Logical	1		N
35	PAFP	Logical	1		N
36	PABB	Logical	1		N
37	PLR	Logical	1		N
38	PLF	Logical	1		N
39	DIAP	Logical	1		N
40	YW	Logical	1		N
41	WW	Logical	1		N
42	UT	Logical	1		N
43	TSWG	Logical	1		N
44	FW	Logical	1		N
45	CDDW	Logical	1		N
46	MUN1	Numeric	5		N
47	MUN2	Numeric	5		N
48	MUN3	Numeric	5		N
49	MUN4	Numeric	5		N
50	MUN5	Numeric	5		N
51	MUN6	Numeric	5		N
52	MUN7	Numeric	5		N
53	MUN8	Numeric	5		N
54	MUN9	Numeric	5		N
55	MUN10	Numeric	5		N
56	MUN11	Numeric	5		N
57	MUN12	Numeric	5		N
58	MUN13	Numeric	5		N
59	MUN14	Numeric	5		N

Page # 2

60 MUN15

Numeric

5

M

** Total **

482

Structure for database: C:\MOEMS\JUNCODE.DBF

Number of data records: 1003

Date of last update : 07/23/90

Field	Field Name	Type	Width	Dec	Index
1	MUNNAME	Character	30		N
2	MUN	Numeric	6		Y
3	POP	Numeric	9		N
** Total **			46		

Structure for database: C:\MOEMS\RECYCLE.DBF

Number of data records: 46

Date of last update : 11/05/90

Field	Field Name	Type	Width	Dec	Index
1	CTY	Numeric	5		N
2	MUN	Numeric	5		N
3	AGENTNO	Numeric	2		Y
4	CONTACT	Character	30		N
5	PROGTYPE	Character	2		N
6	BBOXPROG	Logical	1		N
7	DEPOTPROG	Logical	1		N
8	BLUEBOX	Numeric	12		N
9	PANP1987	Numeric	10		N
10	GLAS1987	Numeric	10		N
11	TIN1987	Numeric	10		N
12	ALUM1987	Numeric	10		N
13	TOTAL1987	Numeric	10		N
14	PANP1989	Numeric	10		N
15	GLAS1989	Numeric	10		N
16	TIN1989	Numeric	10		N
17	ALUM1989	Numeric	10		N
18	PET1989	Numeric	10		N
19	TOTAL1989	Numeric	10		N
20	COST1987	Numeric	11		N
21	OPER1988	Numeric	11		N
22	CAP1988	Numeric	11		N
23	OPER1989	Numeric	11		N
24	CAP1989	Numeric	11		N
** Total **			224		

Structure for database: C:\MOENSW\RESCOM87.DBF

Number of data records: 1

Date of last update : 10/25/90

Field	Field Name	Type	Width	Dec	Index
1	COMP87	Numeric	4		Y
2	PANP	Numeric	9	4	N
3	PAFP	Numeric	9	4	N
4	PABB	Numeric	9	4	N
5	PAOCC	Numeric	9	4	N
6	PAMAG	Numeric	9	4	N
7	PAMIX	Numeric	9	4	N
8	PATB	Numeric	9	4	N
9	PACP	Numeric	9	4	N
10	PAOTH	Numeric	9	4	N
11	GLFB	Numeric	9	4	N
12	GLOTH	Numeric	9	4	N
13	TSFB	Numeric	9	4	N
14	TSWG	Numeric	9	4	N
15	TSOTH	Numeric	9	4	N
16	ALFB	Numeric	9	4	N
17	ALOC	Numeric	9	4	N
18	ALFL	Numeric	9	4	N
19	ALOTH	Numeric	9	4	N
20	PLHD	Numeric	9	4	N
21	PLPET	Numeric	9	4	N
22	PLR	Numeric	9	4	N
23	PLF	Numeric	9	4	N
24	FW	Numeric	9	4	N
25	YWLGW	Numeric	9	4	N
26	YWOTH	Numeric	9	4	N
27	WW	Numeric	9	4	N
28	CD	Numeric	9	4	N
29	CDOTH	Numeric	9	4	N
30	DIAP	Numeric	9	4	N
31	UT	Numeric	9	4	N
32	HHW	Numeric	9	4	N
33	OTH	Numeric	9	4	N
** Total **			293		

Structure for database: C:\MOEMSW\SIC49538.OBF

Number of data records: 65

Date of last update : 11/18/90

Field	Field Name	Type	Width	Dec	Index
1	DUNSNUM	Numeric	9		N
2	NATCODE	Numeric	3		N
3	COUNTRYCD	Numeric	3		N
4	PROVINCECD	Numeric	2		N
5	CITYCODE	Numeric	4		N
6	BLANK1	Numeric	1		N
7	BUSNAME	Character	30		N
8	STREETADD	Character	25		N
9	MAILADD	Character	22		N
10	CITYNAME	Character	13		N
11	PROVINCENM	Character	2		N
12	BLANK2	Numeric	2		N
13	POSTALCODE	Character	7		N
14	TELEPHONE	Numeric	12		N
15	CEO	Character	19		N
16	BUSTYPE	Character	19		N
17	STARTYEAR	Numeric	4		N
18	ZEROES1	Numeric	7		N
19	SALESFIG	Numeric	12		N
20	ZEROES2	Numeric	5		N
21	EMPLHERE	Numeric	6		N
22	EMPLTOTAL	Numeric	6		N
23	SIC1	Numeric	4		N
24	SIC2	Numeric	4		N
25	SIC3	Numeric	4		N
26	SIC4	Numeric	4		N
27	SIC5	Numeric	4		N
28	SIC6	Numeric	4		N
29	SECNAME	Character	30		N
30	HDQTCITY	Character	13		N
31	HDQTPROV	Character	4		N
32	HDQTOFFICE	Character	3		N
33	HDQTDUNSHO	Numeric	9		N
34	PARDUNSHO	Numeric	9		N
35	ULTDUNSHO	Numeric	9		N
36	STATUS	Numeric	2		N
37	SUBSIDIARY	Character	1		N
38	MANIND	Character	1		N
39	LANGIND	Character	1		N
40	FILLER	Character	4		N
41	NDGCODE	Numeric	4		N
42	SMSACODE	Numeric	3		N
43	CDNSIC1	Numeric	4		N
44	CDNSIC2	Numeric	4		N
45	CDNSIC3	Numeric	4		N
46	CDNSIC4	Numeric	4		N
47	FILLER2	Numeric	5		N
48	DBREPOFF	Numeric	3		N
49	TRANSCODE	Numeric	1		N
50	REASONCODE	Numeric	2		N
51	TRANSDATE	Numeric	6		N
52	NUMBER	Numeric	3		N
53	DUNSNUMBER	Numeric	9		N
54	Q1A1	Numeric	1		N
55	Q1A11	Numeric	1		N
56	Q1A111	Numeric	1		N
57	Q1B1	Numeric	3		N
58	Q1B11	Numeric	3		N
59	Q1B111	Numeric	3		N

60	Q2	Numeric	3	N
61	Q3	Numeric	1	N
62	Q4	Numeric	1	N
63	Q5	Numeric	1	N
64	Q6	Numeric	8	N
65	Q7	Numeric	8	N
66	Q8I	Numeric	2	N
67	Q8II	Numeric	2	N
68	Q8III	Numeric	2	N
69	Q8IV	Numeric	2	N
70	Q8V	Numeric	2	N
71	Q8VI	Numeric	2	N
72	Q8VII	Numeric	2	N
73	Q8VIII	Numeric	2	N
74	Q8IX	Numeric	2	N
75	Q8X	Numeric	2	N
76	Q9AI	Numeric	3	N
77	Q9AII	Numeric	3	N
78	Q9AIII	Numeric	3	N
79	Q9BIC	Numeric	1	N
80	Q9BID	Numeric	6	N
81	Q9BIC	Numeric	1	N
82	Q9BID	Numeric	6	N
83	Q9BIIIC	Numeric	1	N
84	Q9BIIID	Numeric	6	N
85	Q10I	Numeric	3	N
86	Q10II	Numeric	3	N
87	Q10III	Numeric	3	N
88	Q11A1Y	Numeric	1	N
89	Q11A1F	Numeric	1	N
90	Q11A1T	Numeric	1	N
91	Q11A1G	Numeric	1	N
92	Q11A2Y	Numeric	1	N
93	Q11A2F	Numeric	1	N
94	Q11A2T	Numeric	1	N
95	Q11A2G	Numeric	1	N
96	Q11A3Y	Numeric	1	N
97	Q11A3F	Numeric	1	N
98	Q11A3T	Numeric	1	N
99	Q11A3G	Numeric	1	N
100	Q11A4Y	Numeric	1	N
101	Q11A4F	Numeric	1	N
102	Q11A4T	Numeric	1	N
103	Q11A4G	Numeric	1	N
104	Q11A5Y	Numeric	1	N
105	Q11A5F	Numeric	1	N
106	Q11A5T	Numeric	1	N
107	Q11A5G	Numeric	1	N
108	Q11A6Y	Numeric	1	N
109	Q11A6F	Numeric	1	N
110	Q11A6T	Numeric	1	N
111	Q11A6G	Numeric	1	N
112	Q11A7Y	Numeric	1	N
113	Q11A7F	Numeric	1	N
114	Q11A7T	Numeric	1	N
115	Q11A7G	Numeric	1	N
116	Q11B1	Numeric	3	N
117	Q11B1I	Numeric	3	N
118	Q11B1II	Numeric	3	N
119	Q11B1V	Numeric	3	N
120	Q11BV	Numeric	3	N
121	Q11BVI	Numeric	3	N
122	Q11BVII	Numeric	3	N
123	Q12	Numeric	1	N

124	Q13I	Numeric	3	N
125	Q13II	Numeric	3	N
126	Q13III	Numeric	3	N
127	Q14AI	Numeric	3	N
128	Q14AII	Numeric	3	N
129	Q14AIII	Numeric	3	N
130	Q14AIV	Numeric	3	N
131	Q14AV	Numeric	3	N
132	Q14AVI	Numeric	3	N
133	Q14AVII	Numeric	3	N
134	Q14AVIII	Numeric	3	N
135	Q14AIX	Numeric	3	N
136	Q14AX	Numeric	3	N
137	Q14AXI	Numeric	3	N
138	Q14AXII	Numeric	3	N
139	Q14AXIII	Numeric	3	N
140	Q14BIC	Numeric	1	N
141	Q14BIIIC	Numeric	1	N
142	Q14BIIIC	Numeric	1	N
143	Q14BIVC	Numeric	1	N
144	Q14BVC	Numeric	1	N
145	Q14BVIC	Numeric	1	N
146	Q14BVIIIC	Numeric	1	N
147	Q14BVIIIC	Numeric	1	N
148	Q14BIXC	Numeric	1	N
149	Q14BXC	Numeric	1	N
150	Q14BXIC	Numeric	1	N
151	Q14BXIIIC	Numeric	1	N
152	Q14BXIIIC	Numeric	1	N
153	Q14BID	Numeric	6	N
154	Q14BIID	Numeric	6	N
155	Q14BIIID	Numeric	6	N
156	Q14BIVD	Numeric	6	N
157	Q14BVD	Numeric	6	N
158	Q14BVID	Numeric	6	N
159	Q14BVIID	Numeric	6	N
160	Q14BVIIID	Numeric	6	N
161	Q14BXID	Numeric	6	N
162	Q14BXID	Numeric	6	N
163	Q14BXID	Numeric	6	N
164	Q14BXIID	Numeric	6	N
165	Q14BXIIID	Numeric	6	N
166	Q15I	Numeric	2	N
167	Q15II	Numeric	2	N
168	Q15III	Numeric	2	N
169	Q15IV	Numeric	2	N
170	Q15V	Numeric	2	N
171	Q15VI	Numeric	2	N
172	Q15VII	Numeric	2	N
173	Q15VIII	Numeric	2	N
174	Q15IX	Numeric	2	N
175	Q15X	Numeric	2	N
176	Q15XI	Numeric	2	N
177	Q16AI	Numeric	3	N
178	Q16AII	Numeric	3	N
179	Q16AIII	Numeric	3	N
180	Q16AIV	Numeric	3	N
181	Q16AV	Numeric	3	N
182	Q16AVI	Numeric	3	N
183	Q16AVII	Numeric	3	N
184	Q16AVIII	Numeric	3	N
185	Q16AIX	Numeric	3	N
186	Q16BI	Numeric	1	N
187	Q16BII	Numeric	1	N

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188	Q168III	Numeric	1	N
189	Q168IV	Numeric	1	N
190	Q168V	Numeric	1	N
191	Q168VI	Numeric	1	N
192	Q168VII	Numeric	1	N
193	Q168VIII	Numeric	1	N
194	Q168IX	Numeric	1	N
195	FIRST	Character	15	N
196	LAST	Character	15	N
197	TITLE	Character	15	N
**	Total	**	761	

Structure for database: C:\MOENSW\SIC5093.DBF

Number of data records: 285

Date of last update : 11/20/90

Field	Field Name	Type	Width	Dec	Index
1	DUNSNUM	Numeric	9		N
2	MATCODE	Numeric	3		N
3	COUNTRYCD	Numeric	3		N
4	PROVINCECD	Numeric	2		N
5	CITYCODE	Numeric	4		N
6	BLANK1	Numeric	1		N
7	BUSNAME	Character	30		N
8	STREETADD	Character	25		N
9	MAILADD	Character	22		N
10	CITYNAME	Character	13		N
11	PROVINCENM	Character	2		N
12	BLANK2	Numeric	2		N
13	POSTALCODE	Character	7		N
14	TELEPHONE	Numeric	10		N
15	CEO	Character	19		N
16	BUSTYPE	Character	19		N
17	STARTYEAR	Numeric	4		N
18	ZEROES1	Numeric	7		N
19	SALESFIG	Numeric	12		N
20	ZEROES2	Numeric	5		N
21	EMPLHERE	Numeric	6		N
22	EMPLTOTAL	Numeric	6		N
23	SIC1	Numeric	4		N
24	SIC2	Numeric	4		N
25	SIC3	Numeric	4		N
26	SIC4	Numeric	4		N
27	SIC5	Numeric	4		N
28	SIC6	Numeric	4		N
29	SECNAME	Character	30		N
30	HDQTCITY	Character	13		N
31	HDQTPROV	Character	4		N
32	HDQTOFFICE	Character	3		N
33	HDQTDUNSNO	Numeric	9		N
34	PAROUNSNO	Numeric	9		N
35	ULTDUNSNO	Numeric	9		N
36	STATUS	Numeric	2		N
37	SUBSIDIARY	Character	1		N
38	MANIND	Character	1		N
39	LANGIND	Character	1		N
40	FILLER	Character	4		N
41	WDGCODE	Numeric	4		N
42	SMSACODE	Numeric	3		N
43	CDNSIC1	Numeric	4		N
44	CDNSIC2	Numeric	4		N
45	CDNSIC3	Numeric	4		N
46	CDNSIC4	Numeric	4		N
47	FILLER2	Numeric	5		N
48	DBREPOFF	Numeric	3		N
49	TRANSCODE	Numeric	1		N
50	REASONCODE	Numeric	2		N
51	TRANSDATE	Numeric	6		N

** Total **

362

Structure for database: C:\MOEMSW\TRANSFER.OBF

Number of data records: 29

Date of last update : 10/01/90

Field	Field Name	Type	Width	Dec	Index
1	COUNTY	Numeric	5		N
2	OPERATOR	Character	20		N
3	MUN1	Character	5		N
4	MUN2	Character	5		N
5	MUN3	Character	5		N
6	MUN4	Character	5		N
7	LOCATION	Numeric	5		N
8	DESTINATN	Character	15		N
9	WASTE	Character	7		N
10	TIPFEE	Character	5		N
** Total **			78		

